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Compulsory adoption of the block system is the object of a bill now before the New Jersey Legislature. According to its provisions, all steam railways in the state must adopt the block system before July 1, 1894.

The American Iron and Steel Association reports upon the iron trade in 1893 practically as follows, the tabulation being ours:

	1893. Gross tons.	1892. Gross tons.
Total production of pig iron	7,124,502	9,158,000
Pig iron produced, 1st half of year.	4,562,913	4,769,683
" " 2d " "	2,561,584	4,387,317
Pig iron unsold Dec. 31	662,068	506,116
Bessemer steel ingots produced.....	3,193,524	4,168,435
" " rails.....	1,076,353	1,458,732
Steel rails made, 1st half of year....	704,240	.....
" " " 2d " "	332,113	.....
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This short table shows that while the pig iron production of the first half of 1893 exceeded that of the last half of 1892, the heavy falling off in that and the other products noted was in the latter half of last year. The steel rail output of 1893 was the smallest since 1885.

The new steel bridge across the Missouri River at Bellefontaine Bluffs, on the new Chicago, Burlington & Quincy line into St. Louis, Mo., has been completed and will soon be opened for traffic. This bridge is a part of the extended improvements, which the Burlington company has been at work on for the past two years, to furnish it an independent line into St. Louis for that part of its system west of the Mississippi River. The bridge is a double-track structure, and, beginning at the south end, consists of four river spans, each 440 ft. long and weighing 2,800,000 lbs., a viaduct 850 ft. long and 2,000 ft. of wooden trestle, which will be filled. The south bank is so steep that a short bank carries the track to the south river span. There are four piers in the river on pneumatic caissons. The deepest was sunk 101.87 ft. below standard low water. Three of the caissons are 30 × 70 ft. and one 24 × 60 ft., and the caissons and cribs are of varying heights from cutting edge to the masonry. These piers and the abutment on the south end are of Bedford limestone, faced, between high and low water, with St. Cloud granite. The viaduct is on 27 pairs of brick piers, which support steel towers. There are in all 28 spans, and the girders are 30 ft. 4 ins. long. The posts are spaced 28 ft. 6 ins. and 32 ft. 2 ins. The bridge proper consists of four spans of 440 ft. each, the trusses being 55 ft. deep and 30 ft. apart between centers. The entire superstructure is of steel, all the riveted work being reamed. The charter for the bridge was secured in 1889. Soundings were commenced at various points between St. Charles and the mouth of the river in April, 1889, and one year later the Bellefontaine Bluff site was selected. Work was commenced on July 1, 1892, and the piers were completed July 4, 1893. Connection was made with the bridge and Texas Junction Jan. 14, 1893.

The pure water agitation still continues at Allegheny and Pittsburg, Pa., although some indifference to the vital question under discussion at Allegheny seems to exist. At Pittsburg a committee has recommended sand filtration. This committee is composed as follows: From the Engineers' Society of Western Pennsylvania, Messrs. Chas. Davis, Jas. H. Harlow, Geo. S. Davison, Gustave Kaufman, all members of the American Society of Civil Engineers, and Saml. Discher; from the Pittsburg Chamber of Commerce, Mr. Thos. P. Roberts; from the Allegheny County Medical Society, Dr. E. G. Matson. The committee's report was signed by all the above with the exception of Mr. Discher and Mr. Roberts, the latter making a minority report in favor of either mechanical filtration or sedimentation. The committee recommended: (1) Covered filter beds to work at a rate not exceeding 3,000,000 gallons per acre per day, to be operated under the supervision of an expert. (2) Water to be taken from infiltration galleries beneath the bed of the Allegheny River, with a bottom area of not less than 4,000 ft. per 1,000,000 gallons daily demand, the object of the galleries being to take the place of subsiding reservoirs and provision to be made for cleaning by backflushing. (3) Possibly some well defined manufacturing districts might be supplied with unfiltered water for industrial purposes. (4) The entire consumption should be metered, meters to be introduced gradually, beginning with the larger consumers and those suspected of wasting water.

The most serious railway accident of the week was a head collision on the Bennington & Rutland Ry. at South Shaftsbury, Vt., Jan. 16. A northbound passenger train ran into a southbound wrecking train, owing to carelessness on the part of the train dispatcher. Two men were killed.

Another serious accident was a collision between the two sections of a freight train which had broken apart on the Pittsburg, Chicago & St. Louis R. R. near Steubenville, O., Jan. 20. Five cars were thrown down the bank and two men were killed.

A locomotive boiler explosion occurred Jan. 14 at Winchester, Ind., on the Cleveland, Cincinnati, Chicago & St. Louis Ry. The engine was hauling a freight train when the accident happened. The fireman was killed, and the engineman and a brakeman were injured.

A temporary construction trestle near Fair View, N. J., on the New York, Susquehanna & Western R. R. new line to the Palisades tunnel gave way under a loaded gravel train, Jan. 17. A bank across the meadows is being built with spoil from the tunnel, and the cars are backed out on a light trestle in advance of the bank. It is reported that the engineman had been ordered not to back more than one loaded car on the trestle at a time, but at the time of the accident he had four cars of a six-car train standing on the trestle. The structure collapsed suddenly and about 35 men engaged in unloading the dirt cars went down, one man being killed and 28 more or less injured.

Nickel mining at Sudbury, Ont., is the subject of a paper read before the Engineering Society of the School of Practical Science, Toronto, by Mr. T. J. McFarley. The body of the paper is devoted to the methods of extraction and reduction; but the following items of output are abstracted: The daily product of the smelter at the Blizzard mine is about 26,000 lbs. of matte containing about 25% of nickel and 20% of copper. Or, to put it in other terms, 13 tons of matte, containing about 3½ tons of nickel, worth about $4,000, and 2½ tons of copper, worth $400. In the year ending Oct. 31, 1892, the total output of the Sudbury district was 61,924 short tons of nickel and copper ore smelted, giving 6,278 tons of matte. The product of nickel, including that from 1,800 tons of Bessemerized matte, was 2,062 tons; copper, 1,936 tons; cobalt, 8½ tons. The nickel output from this region in 1890 was about 668 tons.

A movable sidewalk, similar to that at the World's Columbian Exposition, is recommended by the Board of Directors of the Central Construction Co. for the operation of the long-talked-of loop line to connect the several downtown termini of the elevated railways in Chicago. In their report made recently the board summarizes the conclusions and recommendations resulting from a several-months study of the problem as follows:

Your committee considers it of great importance to adopt a system which shall not only easily and quickly gather up and distribute passengers for the elevated roads, but shall also provide means to reach the steam railway stations, the hotels, theaters and other places of amusement, and accommodate those who desire to go from one part of the business district to another with comfort and safety. It therefore recommends a system of elevated belt lines, preferably on Wabash Ave., Fifth Ave., Polk St. and South Water St., with cross lines, say, on Madison or Washington St. and perhaps Adams or Van Buren St. consisting of continuous moving platforms driven by electric motors and supported upon single posts at the curb line, moving in opposite ways on opposite sides of the street, provided with convenient bridges and platforms for the transfer of passengers from one line to another, a single fare to cover any number of such transfers. . . . The double-track system recommended is the equivalent of eight miles of single track or platform. While we have not made exact estimates, it is evident that it can be constructed for a moderate sum per mile.

The Central Construction Co. is the outgrowth of the Defensive Association formed some time ago by the property owners in the downtown district to prevent the construction of individual loop lines by the different elevated railway companies.

The New Jersey State Road Improvement Association held a meeting at Trenton on Jan. 19. President Edwin Burrough stated that 36 miles of stone road had been secured last year through state aid, in Camden, Burlington and Middlesex counties. For this year 33 miles are approved and under construction, and 36 miles more have been applied for which cannot be built under the present appropriation. It was agreed to recommend the following amendments to the Road Law:

First—That the amount to be appropriated by the county in any one year for road building and repairs shall not exceed one-fourth of 1% on the ratables of said county.

Second—That the state shall pay 40%; the townships, 25%; the adjacent taxpayers, 10%, and the county the balance.

Third—That after the word "stone" in the section describing the material of the roadbed, be inserted the words "oyster shell, gravel or iron bog ore."

Fourth—That the Board of Freeholders shall select, from the roads petitioned for, the ones to be built, they having in mind the ones most used, and the distribution of the benefit to all parts of the county.

Fifth—That the President of the State Board shall not approve of more roads in one year than the state appropriation will pay its 40% of the building, nor the Board of Freeholders put under contract in any year more than the year's appropriation will pay for.

Mr. C. C. McBride, of Elizabeth, was elected President for the ensuing year, and Mr. Franklin Dye, of Trenton, was made Secretary and Treasurer.

The bill to authorize the New York & New Jersey Bridge Co. to build a bridge over the Hudson River at about 70th St., New York city, was vetoed by the President on Jan. 20. In his message the President stated that the bill contemplated the construction of a bridge with piers in the river, and he doubted whether, if the bill became law, the Secretary of War would have the right to require the company to erect a bridge spanning the entire width of the river. Much objection has been made to the location of river piers, and it is questionable whether such piers should be permitted, as it seems certain that within a few years a great volume of shipping will extend to that location, which would be seriously embarrassed by such obstruction. He stated that while he appreciated fully the importance of railway communication across the river, he did not consider it wise to interfere in any way with the commerce of the river, and "engineers whose judgment upon the matter cannot be questioned, including the engineer of the company proposing to build this bridge, have expressed the opinion that the entire river can be spanned safely and effectively by a suspension bridge or a construction not needing the use of piers." The company was created by an act of the New York state legislature (which became a law on April 30, 1890, by reason of the failure of the governor to approve or veto the same), and that law provided for a single span, without towers or piers between the existing pier head lines on both sides of the river, and it is to be assumed that the members of the legislature knew what was necessary for the protection of the commerce of New York city. Further, the proposed bill appeared to authorize the bridge company to charge a toll, in addition to the railway charges, on the mails, which should not be permitted. Another important objection was that a clause was inserted in the bill providing that any company already created for the purpose of bridging the river might avail itself of the provisions of the act. This would release the North River Bridge Co. from the prohibition to construct piers in the river, which was contained in its act, and would thus, in effect, give it a new charter. The reasons against obstructions in the river become still more serious when applied to the location of this latter bridge, which would be about two miles below 23d St., and in a very busy portion of the river.

The 2,000-ton cruiser "Montgomery," on her trial trip of Jan. 19 made 18.85 to 19 knots of corrected speed in Long Island Sound, as against a contract speed of 17 knots. The contract maximum I. HP. was 5,400, though the official returns of the trial are not yet published.

THE METROPOLITAN SEWERAGE SYSTEMS OF MASSACHUSETTS.

(With inset.)

A glance at the map of Boston and suburbs, presented on the inset sheet in this issue, shows that these municipalities in many of their public needs are by nature one, a Greater Boston, embracing more individual communities than are included in the proposed Greater New York.

Already the original Boston has been increased from an area of less than 3 to nearly 37 sq. miles by the annexation of East and South Boston, Roxbury, Dorchester, West Roxbury, Charlestown, Brighton and Breed's and Deer Islands. Already the Boston water-works supply the outlying municipalities of Chelsea, Everett and Somerville, with a combined population in 1890 of nearly 75,000, while, encouraged by the good results being obtained in connection with the Metropolitan sewerage system, presently to be described, the Massachusetts Legislature of 1893 authorized the State Board of Health to make investigations for a Metropolitan water supply. Thus with a common water supply for four of these communities and a prospect of its extension to others, with a common main sewerage system already in operation for some of them and under construction for many more, and with business interests largely in common, these cities and towns are gradually becoming one in fact, if not in name.

While their complete consolidation is made easier by these combinations to supply municipal needs, it may also be postponed, for if the co-operative plan proves satisfactory, the benefits of combination may be secured while the charms and advantages of individual municipal existence are still retained, which latter are very attractive to the inhabitants of the old Bay State with their traditions of town meetings and local self-government.

The Metropolitan sewerage system really comprises two distinct systems, the Charles River Valley and the North Metropolitan. The Charles River Valley system lies entirely to the south of the Charles River and connects with the intercepting sewer of the Boston main drainage system (Eng. News, May 8, 1880, and Feb. 10, 1883), which discharges at Moon Island, as shown by the map on the accompanying inset sheet. The cost of the Boston main drainage, including pumping plant and reservoirs, was about $4,250,000.

The sewage from the North Metropolitan system will discharge into the ocean continuously, without being first received in reservoirs to be held until ebb tide, as is the case with the combined sewage of the Boston main drainage and the Charles River Valley systems.

The estimated cost of the Charles River system was about $800,000, and of the other about $4,400,000. This cost is first met by bonds issued by the state, but the bonds are to be redeemed by means of sinking funds to which each municipality is to pay a certain percentage of the whole and is to contribute to the interest account in the same way. The cost of operation is also to be met jointly by the towns and cities concerned. In November, 1891, the apportionments for sinking fund and maintenance were made for the five years 1891 to 1895, inclusive, by three commissioners appointed by the State Supreme Court, in accordance with the provisions of the act under which the work is being done. The commissioners were Messrs. Ebenezer R. Hoar, Wm. C. Endicott and John E. Sanford.

The names and populations of the several municipalities included in each system, together with the percentage of sinking fund and interest and also of maintenance which each is to pay in the respective systems, are given in Table I. The actual cost of the two systems not being known at the time of the report, and there being a common fund for the construction of each, it was estimated that the North Metropolitan system would cost 85% of the whole and the apportionments were made on that basis. The commission which made these awards considered percentages only. Regarding the method of arriving at these percentages the commissioners of award state:

> We have come to the conclusion that there is, upon the whole, no method more just and equitable than to apportion the payments on account of the interest and sinking fund requirements of the loan, which represents the first cost of the systems, with primary reference to the total taxable valuations of the several cities and towns; and the payments on account of the cost of maintenance and operation, with primary reference to their respective populations; making, however, in both cases, such deductions or allowances in favor of any city or town as upon the facts justice and equity may seem to require. Thus, for example, the valuation and population of areas which are physically so situated that they cannot be drained into these systems have been excluded in favor of the cities and towns within whose limits such areas lie.
>
> The valuations of May 1, 1890, and the national census of that year have been used for the purposes aforesaid. To the total values of real and personal estate, as assessed by the local boards, have been added the values, as furnished us by the tax commissioner, of all bank and corporation stocks and ships and vessels, the taxes on which are paid or accrue under state laws to the several cities and towns.

The sewers are designed to serve the estimated population of 1930, which was calculated by making a separate study for each municipality. The estimate shows a probable total population in 1930 about double that of 1890.

Regarding the rates of flow per capita, Mr. Howard Carson, Chief Engineer, states in his report for the year ending Sept. 30, 1892:

> The maximum rate of flow is taken at 35 cu. ft., or 262 gallons, per head per day for Somerville and Cambridge, and at 30 cu. ft., or 224 gallons, per head per day for all other cities and towns. The average rate of flow is taken at 110 gallons per head per day for the population of 1890, and at 120 gallons per head per day for the anticipated population of 1930; the population and rate of flow being considered to increase at a uniform ratio between these years. The minimum rate of flow is taken at two-thirds the average flow in dry seasons. This ratio is derived from some observations upon the flow of sewers in Providence. The average flow in dry seasons is estimated at 117 gallons per head per day in city districts, and at 85 gallons per head per day in suburban districts. The minimum rate of flow is therefore taken at 78 gallons per head per day for Boston, Charlestown, East Boston, Chelsea, Somerville and Cambridge, and at 57 gallons per head per day for all the other cities and towns. Reports of the flow of sewage at the Boston main drainage pumping station indicate that the minimum rate of flow in 1889 at that place was about 82 gallons per head per day. The rates of flow of sewage at the several pumping stations are computed on the supposition that the entire estimated population is connected with the sewers.

TABLE I.—Populations and Percentages of Sinking Fund and Interest and also of Maintenance to be Borne by the several Municipalities in Each of the Metropolitan Sewerage Systems.

	Population, 1890.	P. c. sinking fund and int.	P. c. maintenance.
North Metropolitan System.			
Arlington	5,629	2.45	1.25
Belmont	2 098	1 53	.46
Boston*	81,000	20.45	22.65
Cambridge	70,028	27.87	26.30
Chelsea	27,900	8.46	10.52
Everett	11,088	3.10	4.14
Malden	23,091	7.47	8.68
Medford	11,079	4.94	2.46
Melrose	8,519	2.65	1 86
Somerville	40,152	12.83	15.14
Stoneham	6,155	1.73	1.36
Winchester	4,861	1.99	1.08
Winthrop	2,736	1.32	1.02
Woburn	13,499	3.61	2.99
Total	306,854	100.00	100.00
Charles River System.			
Boston†	26 210	23.02	25.05
Brookline	12,103	34.32	14.16
Newton	24,379	26.82	29.35
Waltham	18,707	10.61	22.82
Watertown	7,073	5.23	8.62
Total	88,572	100.00	....

* East Boston and Charlestown. † Brighton and part of city proper.

The following general description of the Metropolitan sewerage system, including a brief review of the investigations which led to its inauguration, is from a paper read last December before the Society of Arts, connected with the Massachusetts Institute of Technology, by Mr. Howard Carson, Chief Engineer of the system from its inception to date:

The cities, towns and separate districts, of Boston proper, Charlestown, Cambridge, Somerville, Chelsea, East Boston, Brookline, Brighton, Everett, Winthrop, Watertown, Newton, Waltham, Malden, Melrose, Stoneham, Winchester, Woburn, Medford, Arlington and Belmont are grouped closely together, as is well known (see map on inset sheet). Excluding Boston proper, South Boston, and some other districts tributary to the intercepting sewers mainly completed nine years ago, and shortly to be alluded to, they have an area of about 130 sq. miles and had a population in 1890 of 305,326.

The eight cities first named have had sewers for a long time; the next six towns and cities have had sewers for a few years. The others have few or none, but probably will have in the very early future.

The eight cities first named discharge their sewers, except so far as they have been intercepted, into the nearest estuary, basin or other tidewater. Large areas of mud flats were uncovered by the low tide and gave off during much of the year offensive smells. Years ago this condition of things gave strong offense to the citizens of this area, and it was believed to be dangerous to the public health. Boards of health, many physicians and other citizens remonstrated, and the question of affording relief was vigorously agitated. In 1875 a commission consisting of Civil Engineers E. S. Chesbrough and Moses Lane and Dr. Charles F. Folsom outlined a scheme of relief. They proposed two main drainage systems, one for that part of Boston south of the Charles River and for Brookline, having its outlet at Moon Island; another for Cambridge, Somerville, Charlestown, Chelsea and East Boston, having its outlet at Shirley Gut.

Boston Main Drainage.—A portion of the former system, somewhat modified in route, was adopted. Work was begun upon it in September, 1877, and between six and seven years later it was partly completed and put in operation.

This system is known as the Boston Main Drainage. It consists essentially of intercepting sewers which pass nearly around the peninsula of Boston proper and South Boston and discharge into a trunk sewer which leads to Old Harbor Point. The intercepting sewers are low enough to intercept the flow of sewage in the local sewers, and are mainly lower than the mean low water of the sea. The sewage so intercepted flows to the pumping station at Old Harbor Point, and is there lifted high enough to be discharged at high water into the sea at Moon Island. The system embodies the fundamental ideas of the London system of intercepting sewers and main drainage completed nearly thirty years ago.

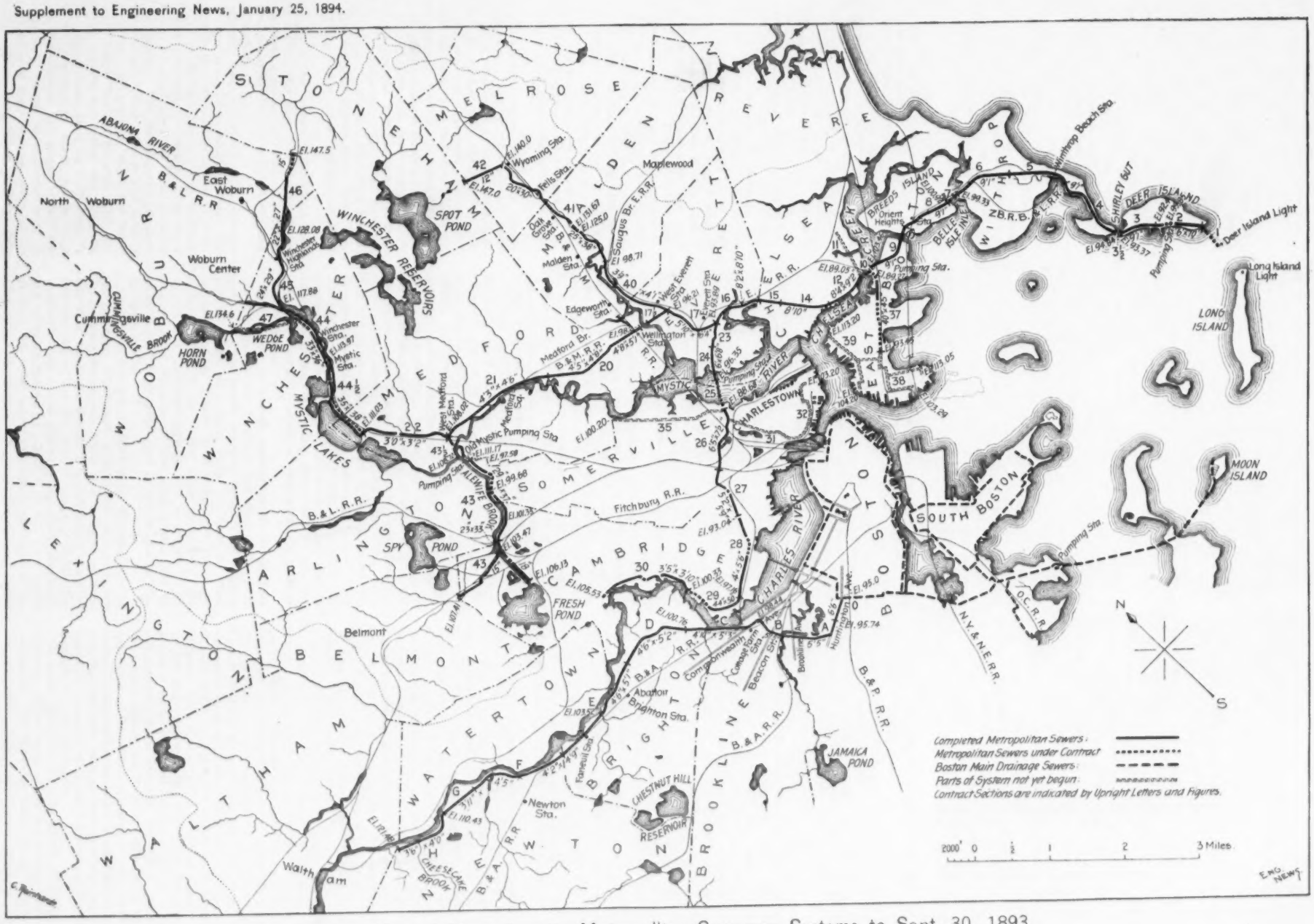
Character of Metropolitan System.—The Metropolitan sewerage system is of a similar character. In its general features it is like that proposed by the commission of Chesbrough, Lane and Folsom, already referred to, but it takes the sewage from 14 additional towns and cities. It consists in reality of two systems, one for Waltham, Newton, Watertown, Brighton, Brookline and the part of Boston lying southwest of Huntington Ave. at Gainsborough St. This trunk sewer is little over eight miles long, and lies wholly south of the Charles River. It connects with the Boston system and finds an outlet at Moon Island. The much more extensive North Metropolitan system lies wholly north of the Charles River, and a considerable part of it lies north of the Mystic River. It has an outlet about one-third of a mile south of the southerly end of Deer Island, or about 1½ miles beyond the Shirley Gut outlet proposed by the Chesbrough Commission.

Between 1875, which was the year of the Chesbrough Commission, and 1887, various studies were made by able commissions and able engineers for disposing of the sewage of the towns and cities outside of Boston proper here referred to. All of these studies helped to contribute to the final result. I cannot now take the space to further refer to them. In 1887 the matter was referred by the legislature to the State Board of Health. This board considered three separate schemes: One for the discharge of crude sewage into a strong tidal current, whence it would be carried to sea beyond return; one for clarification by chemicals, and one for ground filtration. Three engineers were engaged to each study one of the foregoing schemes. The writer was placed in charge of the studies of the first one. The board finally concluded that the second scheme was too costly and not sufficiently effective, and that the third would be impracticable, and they reported to the legislature in January, 1889, in favor of the first scheme, which was estimated to cost in round numbers $5,000,000.

The legislature passed an act, approved June 7, 1889, for a commission of three able and discreet men to be appointed by the governor to construct the Metropolitan sewerage system substantially in accordance with the plan recommended. The board of Metropolitan Sewerage Commissioners, as at first organized, consisted of Hosea Kingman, Tilly Haynes and Dr. Robert Davis. In March, 1892, Harvey N. Collison succeeded Dr. Davis. The board organized in September, 1889, and engaged the writer as engineer in the latter part of October. The winter and spring of 1889-90 were spent in making surveys, studies and plans. The work of construction began the latter part of May, 1890.

The Metropolitan sewer is designed to carry mainly house sewage. Its capacity is based on the estimated population in the year 1930, and is about 225 gallons per head per day for that population. If it was made large enough to take roof-water at the rate, say, of 2½ ins. in five hours from the territory tributary to it, its carrying capacity would have to be increased between four and five times and if it was designed to carry rainwater from the whole surface it would, of course, have to be much larger still.

The Metropolitan sewer south of the Charles River (see inset sheet) has at Gainsborough St., in Boston, a diameter of 6½ ft., which gradually diminishes in size, and eight miles above, at Waltham, is only 3½ × 4 ft. in diameter. It has a fall most of the way of about 2 ft. to the mile. The Charles River line was com-



Progress Map of Massachusetts Metropolitan Sewerage Systems to Sept. 30, 1893.

Howard A. Carson, Chief Engineer.

Hosea Kingman, Tilly Haynes and Harvey N. Collison, Commissioners.

pleted early in the spring of 1892 and has been in operation ever since.

The North Metropolitan system is now so far advanced that it may possibly be completed and in operation by the end of 1894. For its lower five miles it has an average diameter of a little more than 9 ft., and has a fall of about 1¾ ft. to the mile. This system has various branches. One begins in Stoneham, in Montvale Ave., near Oakland station, about 18 miles from Deer Island, where it is to receive most of the sewage from Stoneham. It follows down the valley of the Abbajona River to a point below Winchester and in the bed of the old Middlesex Canal to near the dam between the upper and lower Mystic lakes. At this point it is joined by the old Mystic Valley sewer, built some 15 years ago by the city of Boston (to protect its water supply.—Ed.). The Cummingsville branch (to be built by the board) will discharge into the old sewer. This old Mystic Valley sewer has been purchased by the board and adopted as part of the system to take most of the sewage from Woburn and some from Winchester. The Metropolitan sewer continues down the valley near the Lowell Railroad to West Medford. At West Medford it receives the Alewife Brook branch, which is designed to take the sewage from Belmont, Arlington and part of that from Cambridge, Somerville and Medford. Continuing through Medford the Metropolitan sewer receives at Wellington the so-called Edgeworth branch and will there take the sewage from Edgeworth and the west side of Malden.

The Metropolitan sewer passes under the Malden River by a depressed loop or inverted siphon and joins, near East Everett station, the branch from Stoneham, Melrose and Malden. About three-quarters of a mile farther on in the marsh near the Everett station it joins the so-called Cambridge branch, which is designed to take the sewage from Cambridge, Somerville, Charlestown and parts of Medford and Everett. It then passes through a part of Chelsea and around a part of the water front. Near Eastern Ave. it receives a branch, which is to intercept certain Chelsea sewers discharging into Chelsea Creek north of the railroad bridge. The sewer then passes by a siphon under Chelsea Creek to the pumping station in East Boston. At this pumping station is received the system of intercepting sewers from East Boston and the sewer here takes an upward step of 16 ft. It then passes through a part of East Boston proper and Breed's Island, and under Belle Isle Inlet by another siphon; passes through Winthrop, under Shirley Gut by another inverted siphon, and continues on its way to the middle of the western shore of Deer Island. Here another pumping station is reached, and the sewage is to be lifted to such varying heights as are necessary to discharge into the sea at different stages of the tide. The outfall sewer from this station continues near the western shore of Deer Island to its southerly end, and then passes about 2,000 ft. out into the sea to a point where the sewage is to be discharged.

The so-called Cambridge branch begins in Mount Auburn St., Cambridge, some 15 miles distant from the Deer Island outlet. The route of this metropolitan sewer lies mostly in streets near the bank of the Charles River, and will pass under and intercept the sewers which now discharge into that river. It passes under the McLean Asylum Grounds, in Somerville, and in Sullivan Square, Charlestown, it receives the Charlestown branch. At Arlington St., near Alford St., it will receive a branch designed to take the sewage from parts of Medford and Somerville. The route next lies under the Mystic River, on the east side of the Malden Bridge. Near the middle of Mystic River there is to be a pumping station, where the sewage will be lifted about 9 ft.

The general route of the sewers is indicated upon the map (inset sheet). The sizes and the elevations above the datum plane are also indicated. The datum plane in question lies about 100 ft. below mean low water of Boston harbor.

Location of Pumping Stations.—There are four pumping stations on the North Metropolitan system, the three already alluded to and a small one on the Alewife Brook branch in Somerville, near West Medford.

The question has been asked, "Would it not be a better arrangement to concentrate all these pumping stations at Deer Island?" The discharge of the sewage is to be into the sea, whose average high level is about the same as the salt marshes which are everywhere to be seen about Boston. In order that the sewage shall flow toward the outlet the hydraulic gradient of the sewers must have an inclination in that direction. If the ground on which the dwellings are placed was high enough and sloped toward the sea, pumping might, of course, be dispensed with altogether. As a matter of fact, however, much of the district miles away from Deer Island is lower than Deer Island itself. The Metropolitan sewer, for instance, where it passes under the local sewer in Hawthorne St., Cambridge, near the Charles River, is only 4 ft. above the mean low level of the sea, and from its inclination it of course gets lower and lower as we pass in the direction in which the sewage flows.

If there was no lift at Charlestown the three miles of sewer between that point and East Boston would be 8 ft. deeper than at present. This stretch of sewer already has an average depth of about 25 ft., and the cost of excavation, if made 8 ft. deeper, would be enormously increased. If the sewer still kept on without a pumping station at East Boston all that portion between East Boston and Deer Island would be 24 or 25 ft. deeper than at present. The increased cost of the sewer placed so much deeper would have been counted by hundreds of thousands of dollars. The saving in cost of construction, however, is not the whole or even the principal advantage gained by separating the pumping stations. Without such separation the work of pumping would have been very much increased, for it is clear that all the sewage from districts west of the East Boston pumping station except that from Cambridge, Somerville and Charlestown would have been allowed to fall 8 ft. lower than as now arranged and forever be pumped from this 8-ft. lower level, and that all of the sewage from districts east of the East Boston pumping station would have to be pumped from a depth 24 ft. greater than is necessary by the present arrangement. It is thus seen that the use of several pumping stations does not increase the total work of pumping measured in foot-pounds or otherwise, but, on the contrary, largely decreases it. A further advantage is that the comparatively low lift at each place allows the use of centrifugal pumps. In the matter of weight, space, liability to accidents, and especially in cost of pumps and cost of foundations and buildings, the advantages are in favor of centrifugal as compared with reciprocating pumps. The former, also, from the absence of valves, are better adapted to pumping sewage. Taking into account interest and depreciation on plant and buildings, as well as consumption of fuel and all other items of expense, it is found in the case under consideration that three low-lift stations with centrifugal pumps are at least as economical as one high-lift station with reciprocating pumps. It has already been shown that the cost of sewers in the former case is very much less. Studies were also made for concentrating the pumping at East Boston and using either force mains or a high masonry sewer between East Boston and the point of discharge. It was concluded that the cost of either of these latter designs would be as great as the cost of the deep sewer and concentration at Deer Island previously alluded to, and with the disadvantage that neither would be available for taking the sewage from points east of the East Boston station.

Pumping Engines.—Two engines, with boilers, piping, etc., are now being built for each of the proposed pumping stations at Deer Island, East Boston and Charlestown. Regarding the plant for the first two stations: Each engine is to be capable of easily raising 70 cu. ft. per second (about 45,000,000 gallons per day.—Ed.) of sewage 19 ft. vertically above the level of the sewage pump well, and to raise to greater heights up to 25 ft. quantities of sewage inversely proportional to such lifts. Each is also to be capable of pumping at as low a rate as 15 cu. ft. per second and at all rates between 15 and 70 cu. ft. per second. The pumps will be of the centrifugal type, with vertical shafts. The suction and discharge pipes will be each 48 ins. in diameter, and intended to run at speeds varying from 60 to 100 revolutions per minute, according to the amount of sewage and the height to which it is lifted. The pump wheel is to be driven by a triple expansion engine of the Corliss type. The diameter of the cylinders will be 13½, 24 and 34 ins., with a 30-in. stroke. Condensers will be used. The discharge channels from the pumps will contain check valves, to prevent any backward flow when the pumps are stopped. The inlet channels from the pump wells will be provided with gate valves to admit of closing off the passage when desirable.

The quantity of sewage arriving at the Charlestown pumping station will be about half that at the East Boston or Deer Island pumping station. The engines will be similar in general design to those for East Boston and Deer Island. Each pump will have a capacity of 35 cu. ft. per second, raised 11 ft. high. The suction and discharge openings will be 36 ins. in diameter. The diameter of the pump wheels will be about 8 ft. The cylinders will be 10, 18 and 26 ins., by 30-in. stroke.

Reservoirs and Direct Continuous Discharges.—The sewage from the Boston intercepting system is not continuously discharged. There is a reservoir at Moon Island in which the sewage is stored during the flood and portions of the ebb tide. It seems probable that a reservoir will not be needed on the North Metropolitan sewerage system for years, if at all. Deer Island is about 2½ miles nearer the ocean, measured in the direction of the current, than the outlet of Moon Island reservoir. Experiments and observations appear to demonstrate that no nuisance will be caused for years, if ever, by discharging continuously near Deer Island beacon. The saving in interest alone by direct discharge would within 20 years pay the cost of a reservoir and an additional outlet. The cost of pumping and other items of expense will also be lessened by omitting a reservoir. It may also be noted that storing sewage for a few hours may give an offensive smell which it would not otherwise have. If a reservoir shall be needed it will cost no more to build at a later time, and therefore in any event such building should be postponed until the effect of discharging the sewage continuously is clearly seen.

(To be Continued.)

THE PRACTICABILITY OF ELECTRIC CONDUIT RAILWAYS.

The offer of a cash prize of $50,000, made by the Metropolitan Traction Co., of New York city, for a system of street car propulsion equal to the trolley system but dispensing with overhead wires, has aroused sudden and great interest in this problem, on which not a few inventors have been hard at work for a long time. At the December meeting of the American Institute of Electrical Engineers, Mr. Albert Stetson read a paper with the above title, in which he discussed what has been done in developing competitors to the overhead trolley. Mr. Stetson has been engaged for a year or more in company with Mr. John J. Green, Mr. G. T. Woods and some other inventors in working out a new electric conduit system, which has been successfully tested on an experimental road at Coney Island.

We reprint Mr. Stetson's paper, considerably condensed, as follows:

Two years ago, if an electrical engineer had been asked as to the practicability of an electric conduit railway, he would probably have shrugged his shoulders and expressed great skepticism as to ultimate success. The writer hopes to be able to show that some real progress has been made since then.

Electric traction for street railways has come to stay, and we must choose between the trolley, the secondary battery and a conduit construction (either slotted or closed). The trolley has been, and still is, the most important factor in electric traction. It has and will hold for a long time the field in smaller cities and towns, and for inter-town communication.

But the structure is unsightly, and the poles and wires are a constant menace to the public. A trolley current will not, probably, kill a man who has no organic disease, but it will kill an animal, it will terribly burn any one who comes in contact with it, and would probably cause the death of a man troubled with heart disease. The feed wires are a constant source of danger. A trolley wire may get crossed with an electric light wire carrying an arc current, and it then becomes a dangerous thing. If the streets are at all wide, very large poles, taking up too much sidewalk space, are used, and these invade public rights.

Secondary batteries have been used in nearly every large city of the civilized world, to supply the demands for electric traction, but have been given up as too costly. I know there are still people who are willing to spend their money on this "ignis fatuus," but the number is growing beautifully less year by year. The writer has spent much time in investigating the subject here and abroad, has examined everything in this line that Europe has offered, and he asserts, without fear of successful contradiction, that not one instance can be found in the world where a secondary battery street railway has paid an honest dividend. The cars (if supplied with sufficient power) are too heavy for ordinary track construction, the heaviest ballasted steam track being scarcely good enough to insure them a commercial life. The conditions essential to the life of a secondary battery are large, thick and heavy plates. Such a battery can probably be commercially employed in lighting stations, but those are diametrically opposed to the conditions for a traction battery. To one who understands the principles involved in a successful traction battery, there seems to be nothing in sight to bid us hope for a successful solution of the difficulty from this direction. Should future metallurgists make us acquainted with some new metals, or should a cheap supply of palladium become available, the problem may be changed. But the writer believes the experiments of the E. P .S. company, in England, and those of the Julien company in this country exhausted the possibilities under commercial conditions, and that we have seen no better battery than theirs. Any one trying to work out a system of accumulator traction has my sympathy.

In large cities the cable is a real rival of electric traction, and in many places has proved commercially successful. But there are some things that may give the electrician hope. The cable roads of St. Louis have to a very great extent given up their cable and are using the trolley, while those of Kansas City and Denver are said to be in a bad condition financially. City railroads in the future will, no doubt, be electric, and it is questionable whether any more cable roads will be built. The cost of the powerful machinery re-

quired, the wear and tear upon the cable and the grip, the large amount of real estate required for their buildings constitute serious "first charges" upon the earnings of cable companies, and confine their operations to very large cities where traffic is enormous. Electric traction demands only a portion of the expense necessary for a cable road, and capital is seeking this method for investment, while "fighting shy" of cable roads. When a car is on the track, ready to be moved, it is a question of veracity between the electrician and the cable man as to which motive power can move it more economically. Perhaps the advantage lies a little in favor of the cable man, but when interest on capital invested in buildings, real estate, machinery and the natural deterioration are taken into account, the electrician appears to have much the better of the argument.

There is one other class that may be mentioned in passing, where mechanical motors are employed on the separate cars. Many different motors have been proposed, such as carbonic acid gas, ammonia, gas engines, hydraulic motors and compressed air. None of these have, to my knowledge, demonstrated their commercial utility, though I think the future outlook in this direction is promising.

Open Conduit Electric Railways.

For years electricians have worked to develop a practicable conduit system of electric railway, and many attempts have come near to success. The most extensive, and, until recently, the most successful, was the Bentley-Knight system. An immense amount of money was spent, the best talent was employed, and extensive lines were built at Cleveland and Allegheny City. Experiments were made in New York and Boston, and with the withdrawal from the field of the Bentley-Knight system disappeared the last hope of our being able to place bare wires in a slotted conduit exposed to the severe conditions of our American climate. There is not a city in America to-day where a bare conductor laid in a conduit can earn a dividend on the capital invested. No matter what the system may be, no matter how carefully the insulators may be protected, unless the conduit is made airtight and watertight (which, of course, no slotted conduit can be), mud and dirt will get into the conduit and settle on the conductors. Leakage takes place from a conductor in proportion to the length exposed, and glass, porcelain, ebonite or any other of the so-called insulators, when covered with dirt, conduct the current as well as a similar layer of dirt elsewhere would do.

The following quotations are apropos:

> Without going into details, it is sufficient to say that the conduit system has been tried on an extensive scale in Denver, Cleveland and Boston, and to a lesser extent in several other places, but in every case the continual interference consequent upon its use has exhausted the patience of the traveling public and compelled its abandonment.—F. L. Pope.

> In spite, however, of all this refinement and study, practically nothing has been accomplished; and I have no hesitation in saying that the continuous live conductor in an open slotted conduit is to-day a failure, and that it cannot be made a success throughout our cities of to-day, its fatal weakness being our inability to prevent the conduit from becoming filled with water, mud, etc. The time may come when our sewerage systems will be perfect enough to enable us to overcome this fatal weakness. To-day, however, they are not, and even an optimistic view puts this time a long way distant.—G. W. Mansfield.

I do not say that it is impossible to find men who will still put their money into such systems, but parties working in that direction can well learn from the sad experience of the investors in the Bentley-Knight road. Although I have examined a number of conduits with bare conductors, none of them have shown better construction, such expert technical skill, such regard for the laws of electricity, and none came nearer success than the Bentley-Knight road. It is the same old story, too great expense and the impossibility of insulation.

In one of the patents owned by this company the inventor says:

> It has been found that upon the insulators there is apt to be an excessive condensation of moisture, owing to the fact that the conduit is beneath the surface of the street, and that at certain times an excessive leakage is apt to occur at certain ones of the insulators. This leakage has a tendency to correct itself; that is, the heat engendered by the passage of the leaking current dries up the moisture which has given rise to it.

True, but that is rather an expensive drying process. Electric energy costs money to produce, and it loses as its distance from the prime motor increases, and then to use it for keeping the streets of cities dry (for it really amounts to that) is hard on the coal pile and the anticipated dividends! The Bentley-Knight conduit system was the harbinger of better things. Splendidly constructed and well managed, but working on the wrong principle, it stands to the commercially practicable conduit road of the present and the future in about the relation of the telephone of Philip Reis to the finished product of Professor Bell's genius.

The Love System.—Of the Love system, now working in Washington, I have not been able to get any accurate or reliable information, and I have heard no favorable reports thereon from impartial authorities. Their conduit is well built, their road is level, and their wires are protected in the same manner as failed to protect the Bentley-Knight conductors. The details do not appear to have been worked out so completely as they were in the Bentley-Knight system. There is the same bare wire in the conduit, and, until the laws of Nature are changed, there must be the same difficulties that have frustrated other attempts in the same direction.

The Buda-Pesth Tramway.—At Buda-Pesth, in Hungary, is the only conduit road employing a bare conductor that has ever achieved measurable commercial success. For a description see Hering's "Recent Progress in Electric Railways," pages 175 et seq.

The width of the slot of the Buda-Pesth road (1 5-16 ins.) is greater than could be allowed in any American city, since it would let into the conduit and wrench the wheels off two-thirds our carriages. This system must have that width, since their conduit uses one of its slot rails as a rail for the wheels of the car, and they must have the width to give room for the flange of the car wheel.

Another point to be noticed above is that they use only 300 volts potential. Most of us believe that Mr. Daft, in his experiments years ago, exhausted the practicabilities of electric traction at 300 volts. But, perhaps, the volts are individually more powerful in Buda-Pesth than the "North American volts" used in New York.

Crosby and Bell's book says (p. 258):

> The conduit of the Buda-Pesth electric railway is seen to possess no very extraordinary features; it is simply well made, substantial and carefully drained. This latter fact is probably the most important factor in the very good results obtained. The concrete conduit is of itself a fair insulator, and serves as an additional security against grounds.

The Buda-Pesth record is certainly remarkable, standing alone as successful among all the failures that have attended conduit experiments. It has not, however, been all plain sailing, and they have had some interruptions in their traffic. What success has attended the Buda-Pesth road has been due to several causes, first of all coming the excellent workmanship that goes with everything done by the world-renowned firm of Siemens & Halske. Next come the beautiful streets of Buda-Pesth, no city in the world excelling it in finely kept and well drained streets. Labor is very cheap there; large numbers of men can be employed to keep the streets clean and the conduit clear, while our dear American labor would make "operating expenses" tell a sad tale. Third, an equable climate, enjoyed in none of our cities. Snow seldom falls there, and the rainfall is not great. Such a state of affairs, so many favorable conditions, would be found nowhere in America, and until they are found combined, there is no good reason for thinking that the Siemens & Halske system, employing the same bare conductor and the same construction that has failed here, would do any more than add one more wreck on the shore of conduit ventures.

Closed Conduit, Railways.—The idea of a closed conduit has had many charms for many inventors. The same difficulty is met with in all of them, viz., the continuous grounding of the live wire. Where magnets are used to switch in short sections of the line they have proved a constant source of trouble. Such things often show up well in the office model, but railroads do not run in offices. All of us who have had any experience with automatic electro-magnetic switching devices know that the less number we have of them the better they work, and that we avoid them wherever it is possible. In the closed conduit or surface contact systems there is necessarily a momentary grounding. On a dry day, with one car, the loss might be hardly noticeable. But, wet and muddy days will come in spite of the prayers of the electrician, and I always picture to myself Broadway on a muddy winter's day, with a jam of cars reaching from the Battery to the Post-Office. Perhaps, there might be 50 or 75 cars in the line, and any system grounded in 75 places will certainly break down.

Among those who have worked most in this field may be mentioned Poliak, Lineff, Gordon, Wheless, Schuckert, Edison and Van Depoele. Their systems have all very much in common, and their fundamental idea is the same.

In the Gordon and the Lineff systems a small conduit 2 or 3 ins. square is closed at the top by an iron cover laid in concrete, and this iron top serves as the current conductor. It is divided up into short lengths, about one-third the length of the car, and these sections are successively alive as the car passes along, and are cut out of circuit when the car has passed.

In the Poliak system there is a middle contact rail in short insulated sections. The conductor carrying the current lies directly beneath this rail, and by means of flexible contacts momentary connections are made from it to that particular section over which the car is at that moment. These temporary connections are made by the aid of a magnet on the bottom of the car, which, in passing over, attracts iron blocks under the rails, making contact with that section.

All will remember the announcement some time ago that Mr. Edison had invented a new system of electric traction destined to relegate the horse to the boneyard and cable and elevated roads to the junk-shop! Such announcements from time to time coming from so eminent a source have done immense harm to electrical enterprises, and they would utterly annihilate the reputation of any man less favorably known than Mr. Edison. Hence there were a few doubters when the pronunciamiento came, and the great results promised have after all failed to materialize. The overhead system, we were told, was to be entirely dispensed with; cars, trucks, tracks and roadbed, such as are now in use, were to be retained, certain changes being made in the joints and crossties. The power, furnished by 1,000-volt generators, was to be distributed to reducing apparatus placed in boiler-plate manholes at intervals varying in accordance with the number of cars required to be operated. At various reducing points the current was to be transformed from 1,000 volts to a pressure of 20 volts, and put in direct communication with the tracks. This limit of 20 volts was fixed in order to prevent horses from being affected by the current. The economy of current was said to be about the same as with the present system of trolley.

The chances are that that road has reached its full growth and will never extend beyond Mr. Edison's laboratory.

Mr. Van Depoele proposed a conduit closed by flexible walls. When the shoe passed, the slot was to be pushed open and the elasticity of the sides of the slot was to close the opening when the car had passed. All right, in theory, but suppose a layer of mud rests on the top of the slot when the car comes along. It opens, lets the mud into the conduit and keeps it there. Such makeshifts will not do. We must work with our streets as we find them. The operative device must be simple and of few parts, and we must keep carefully in mind that a conduit at its best is a dirty place, and that iron and steel will rust, and when rusted may refuse to work. I do not wish to be rash in my judgment, but I see nothing especially promising in any of these closed conduit or surface contact devices.

The Experimental Road at Coney Island.

Such was the state of the art, and such the general outlook for success, when over a year ago I became engaged in some attempts to solve the problem at Coney Island. We set to work to construct a system that should avoid the defects inherent in other devices, and I assert with the utmost confidence that we have succeeded. Perfect insulation, no live wires in the conduit, fewest possible working parts, with nothing to get out of order. These were our cardinal points. We have not attempted to make a road operative in fine weather, and under ideal conditions; but have known that to insure success we must take the streets as we find them. We have, on three occasions, filled our conduit to the top with mud and water, burying out of sight conductors, contact boxes and all the devices. Mud of the consistency of paste was used, and the report of a disinterested electrician, not known to me personally, brought there by the editor of one of our leading electrical journals, shows that the system was in no manner affected. With the shoe of the car in the mud, with boxes entirely submerged, the ordinary measuring instruments failed to show anyhing but the best insulation, and no disturbance of traffic would arise with 50 cars in a conduit filled with mud and water. No such condition would ever present itself in railway work, but a space of several hundred feet might get full of mud, snow or water, and the successful system must not be disturbed by such trifles. We made our mud test not once, but three times. When the last test was made our boxes had been under the mud four days, and it is to those boxes that the expert's report refers. Four days' submergence is a terribly hard test, but if the line then works perfectly, there is absolutely nothing to apprehend from an occasional filling up during a shower.

Description.—A conduit is used similar to that of cable roads, but nothing like so large or expensive. With our improved shoe a conduit 2 or 3 ins. wide and 7 ins. deep will answer perfectly. In the slot of the conduit, attached to the car, runs a shoe extending nearly the length of the car, and so supported that should the car leave the track it detaches itself immediately and remains on the top of the conduit. The shoe is somewhat like a cigar in shape, so as not to give any sharp blow to the contact arms. Its sides are formed of conducting material, insulated from each other and perfectly flexible, so as to follow any curves.

In the conduit are placed two insulated cables, a metallic return being used. This I regard as necessary to insure perfectly safe working. These cables run into and through contact boxes placed at intervals of 10 ft. on each side, they being arranged diagonally opposite, so that the distance between the boxes is about 5 ft.

The main is carried into the box and the lead and insulation removed for about 2 ins. Onto this bared cable there is placed a brass clamp with two upwardly projecting tongues. The contact-making portion of the device is a vertical rod, having at its upper end an arm projecting into the conduit, and at its lower end a brush adapted to be brought into contact with

the tongues attached to the cable. This rod and its bearings must, of course, be properly insulated from the contact box. When no car is passing, the brush is out of all electrical connection with the current conductor, but when the shoe on the car reaches the arm projecting into the conduit it swings it to one side, bringing the brush on the rod into contact with the tongues fastened to the conductor, and the current passes to the motor on the car. As soon as the shoe on the car has passed the box a torsion spring forces the rod back into its normal position and that box is dead. The box is filled as far as it can be without interfering with the movement of the brush with solid paraffine, and above that with "transil oil." This makes excellent insulation. Of course the spindle, which at times becomes "alive," and its bearings are thoroughly insulated from all parts of the box and cable. Nothing can be better than an insulated cable, covered throughout its entire length with a highly resisting material, and at the points where current is supplied to the car the insulation practically infinite.

No accident to persons or animals appears possible with this system. To avoid sparking within the box the ends of the shoe are made of insulating material, thereby establishing mechanical contact within the box before the metallic portion comes into contact with the arm, and also holding the inside contact after the current ceases to flow to the motor. This is an important feature, for without such an arrangement the brushes would soon burn out, the oil become carbonized and the boxes useless.

The question has often been raised as to whether snow and ice would clog up the conduit and stop the car. The experience with the Cleveland Bentley-Knight road shows that the snow did not stop a road with a bare conductor in the conduit, and it certainly could not affect ours. You must drain the conduit, and during such weather as the conduit might get, if left to itself, frozen up, it might be necessary to run a car over the track at intervals all night. But this would only be required once, say, in a winter.

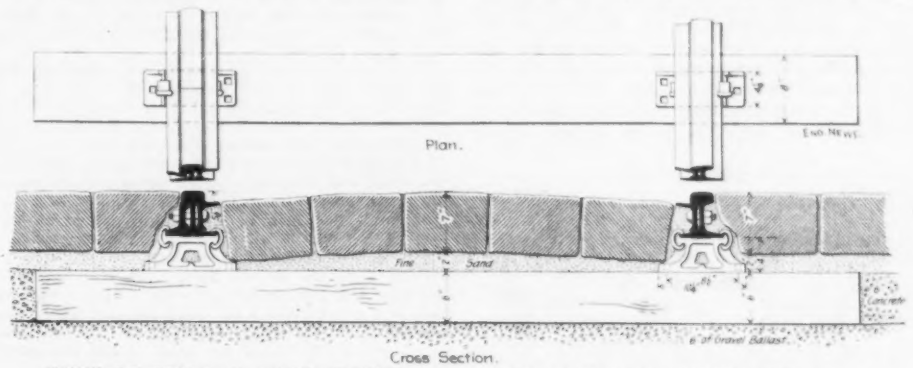
I believe that our road has solved the question of conduit traction. I have not meant in my review of other systems to be in the least unjust to other workers in the same field. I only take my stand on other well-established principles, keep strictly to the laws of nature and electricity, take our climate as it is and our streets as we find them, and I assert, without fear of successful contradiction, that any road to succeed must be laid down practically on these lines.

A conduit system planned on somewhat similar lines to that described by Mr. Stetson has been worked out by Mr. Wm. Lawrence, and is promised to be in practical operation on an exhibition road three-quarters of a mile in length within a month. In the Lawrence system the conductor wire in the conduit is divided into 32-ft. sections, each of which is supported on two "contact boxes," consisting of a porcelain jar with a flexible rubber cover. A trolley runs in the conduit and as soon as it comes onto any section its weight depresses the top of the contact box and causes the charging of that section of the conductor. When the trolley passes off the conductor rises to its former position, and is again dead. The current is distributed to the contact boxes by an insulated underground cable as in the system described by Mr. Stetson. It will be seen that the two systems are alike in doing away with bare live wires in the conduit. A working model of the Lawrence system is on exhibition at No. 13 Astor Place, New York city.

NEW YORK CENTRAL R. R. TRACK THROUGH PAVED STREETS.

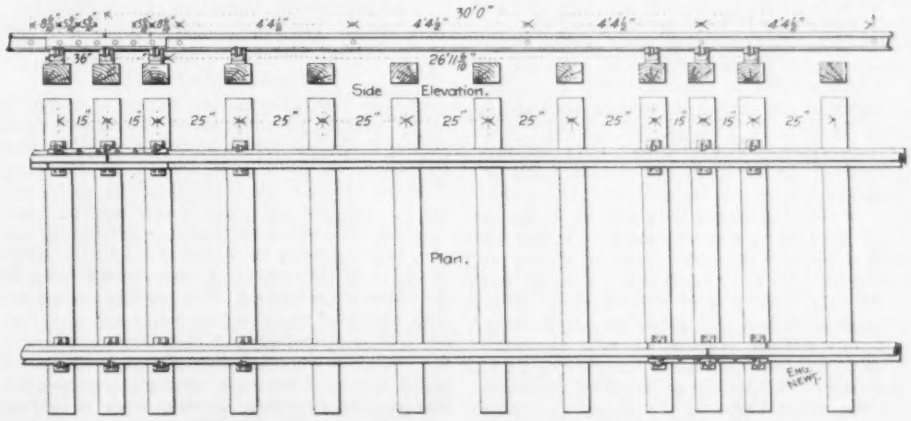
While it is most desirable that railway tracks should be removed from and elevated above city streets, and while such separation of grades has been and is being carried out in many instances, yet there are cases where such separation of grades cannot well be carried out, and in such cases it is of importance, while retaining the use of standard track rails, to provide a good tramway to facilitate as conveniently as possible ordinary vehicle traffic on the streets. The accompanying drawings illustrate a plan designed by Mr. Walter Katte, M. Am. Soc. C. E., M. Inst. C. E., Chief Engineer of the New York Central R. R., for laying the standard railway track in streets paved with stone. It consists essentially in bolting to the inner side of each track rail a form of continuous angle bar, which gives an iron tram rail for ordinary street or wagon traffic, leaving the necessary clearance for wheel flanges on the railway track. The plan has been applied with 65-lb. rails on Hudson, Canal and West Sts., in New York city, and to 80-lb. rails on Washington St., in Syracuse, N. Y., and also to several paved street crossings at grade.

The ties are of wood, 6×9 ins. and 8 ft. long, laid on 6 ins. of gravel ballast, with 6 ins. of concrete between them and extending from their ends to the sides of the street. This concrete rests upon the subgrade of the street, but under the railway track this subgrade is 6 ins. deeper to allow for the gravel ballast. Upon each tie are two Duggan chairs, of cast iron, each secured by three spikes. These chairs have a base of 10¼ × 4¼ ins., and are 4 ins. high. The joint chairs weigh 28 lbs., and intermediate chairs 21 lbs. each. Upon these chairs are laid the track rails, which are secured by taper-driven bent steel spring clamps, as shown. To the inner side of each rail is fastened a special section of angle bar, forming a side bearing rail, with a



STANDARD TRACK IN PAVED STREETS, NEW YORK CENTRAL & HUDSON RIVER R. R.

flangeway of 1 9-32 ins. Over the concrete and ties is a 2-in. layer of fine sand, upon which are set the regular street paving blocks, the blocks outside the rail being level with the top of the rail head, and those between the rails being level with the tread of the angle bar. The two parts of the rail are bolted together at intervals of 4 ft. 4½ ins. At each rail joint a larger chair is used, and the outer clamps bear upon the flange of the angle bar. The continuous inner angle irons break joint with the track rails by about 18 ins., and no inner splice-bar is required, as the angle iron is bolted through



TIE SPACING OF NEW YORK CENTRAL R. R. STANDARD TRACK.

to the rail and outer splice bar at joints as shown.

The ties are laid with the spacing adopted for the standard track of the New York Central R. R., namely, 25 ins. c. to c., with an extra tie under each rail joint, which with broken joints gives three ties, 15 ins. c. to c., at the joints and middle of rails. The angle splice bars are 36i ns. long with six bolts. This uniformly varied spacing of the ties to give additional support to the rail joints is an important feature in trackwork which is not observed as often as it should be.

SHOP AND MILL CONSTRUCTION.*

For many years the cotton and woolen mills in this country have been built with heavy side walls of brick or stone, with an interior construction of wooden beams and posts. One objection to this style of construction is that a sufficient area of side windows to properly light a wide building cannot be obtained, owing to the large amount of space taken up by the brick piers on the sides. Another objection is that owing to insufficient bracing the rapidly moving machinery causes vibrations. This constant vibration has a tendency to weaken the brickwork, and on this account very heavy exterior walls and pilasters are required. To overcome these difficulties the Berlin Bridge Co. has patented a construction which we style our patent mill and shop construction.

The framework of the building consists of metal posts connected together with the necessary purlins, struts and bracings. In order to allow as much light as possible to enter the building we use ribbed glass made in large panes, which is claimed to admit about 93% of the light, and with this style of construction we are enabled to put up buildings from 100 to 125 ft. in width and effectively light them. In order to thoroughly brace the building in every direction we have provided a system of bracing in the end panels and in every fifth or sixth panel throughout the entire length of the building. This, with the angle knee braces, which extend from the posts to the floor beams in each story, and the horizontal bracing in the end and intermediate panels, thoroughly tie the building together so as to prevent vibration. In order that there may be some way to take up the shrinkage of the floor beams we have provided rods extending clear across the building in each panel of story, connected at the ends with the side posts and provided with turnbuckles or other means of adjustment at several points.

The whole interior construction of heavy timbers and plank is based on the "Factory Mutuals" ideas of slow burning construction. The great advantages of our style of building will be appreciated when I call your attention to the statement of a competent authority that the power required to operate spinning frames in a mill which vibrates is 20% greater than is required to operate them in one that is steady. To quote from Woodbury's "Fire Protection of Mills and Construction of Mill Floors": "The consequences of mill vibration in the power absorbed by its exertion in the continual straining of machinery and mill must inevitably tend to damaging results to plant and product."

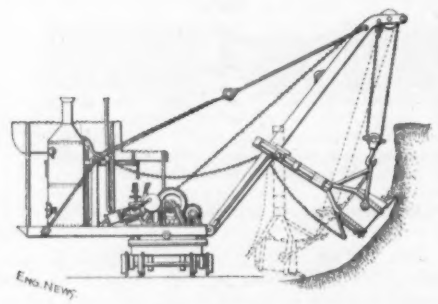
Where the property to be built upon is limited in area a much greater floor space can be obtained than with the present style of construction. Further, this mode of building can go on in the winter as well as in the summer, and the entire construction can be framed indoors during inclement weather, when the

*Abstract of a paper read before the Connecticut Association of Civil Engineers and Surveyors by Burr K. Field, Vice-President Berlin Bridge Co., East Berlin, Conn.

laying of brick would hardly be possible. Thus a building of this kind can be shipped to the site already to be erected above the foundations. This style of construction is not limited to cotton and woolen mills, but can be adapted to foundries, machine shops or any other class of buildings requiring a large amount of light.

A NEW PATTERN OF STEAM SHOVEL.

A novel design of steam shovel, which consists essentially of a boom and bucket attached by a pin joint to the jib of a wrecking crane or grapple, has been brought out by James H. Lancaster, of New York. This boom is readily removed so that the machine may be used as a steam shovel, a clamshell dredge, or a crane. When fitted for the former work the shovel is fed up to its work by a steam cylinder bolted to the dipper boom. In making a cut the engineman lowers the shovel to the required depth and then admits steam to the cylinder to feed the dipper up to the work with the desired force. The lifting drum of the hoisting gear is then started, pulling the dipper up against the face of the cut. The boom is then drawn



A New Form of Steam Shovel.

back by the cylinder, the machine swung round and the load dumped. If any obstruction is met the dipper can be drawn back to clear it by means of the steam cylinder. The machine can be adjusted to excavate from the level of the roadbed or track or to a depth of 3 ft. below that level, and has a reach of 20 ft. in height and 38 ft. in width. The jib or inclined boom is hinged.

The hoisting machine is the same as that hitherto used for the Lancaster grapple, with the exception that pivoted bearings are fitted to the steel boom carrying the shovel, so that the dipper boom can be disconnected and the machine then used as a railway wrecking car, or as an ordinary steam crane. As shown in the accompanying cut the machine is of the locomotive type and carried on a steel truck furnished with wheels to run on standard gage track, and also fitted with four additional wheels on the same axles to run on an outside track of 8, 10 or 12-ft. gage, or on packing rails for either steadying or running the machine when rapidly lifting and swinging heavy loads. The new machines revolve through an entire circle, raise and lower the boom automatically, and the grapples or buckets dig or discharge anywhere within the radial limits of the boom. One man controls all the operations.

REPAIRING A BREAK IN THE LYNDE BROOK RESERVOIR EMBANKMENT.

The construction of reservoir embankments has been much discussed of late before the engineering societies and was taken up by the New England Water-Works Association at its meeting on Jan. 10, when Mr. L. A. Taylor, M. Am. Soc. C. E., of Boston, read a paper on that subject. The bulk of the paper consisted of a description of the repairs to the Lynde Brook reservoir embankment of the water-works of Worcester, Mass., made in 1876 after plans by the late W. J. McAlpine.*

This break was about 200 ft. long and over 40 ft. deep, and was repaired by building an earth embankment with a clay heart-wall, the latter carried well into the earth at each end. The heart-wall extended nearly to the top of the embankment and from the top down was 8 and 10 ft. thick, respectively, for the first and second 10 ft., 12 ft. for the next 12 ft., 16 ft. for the next 10 ft., except as mentioned below.

The method of building the heart-wall is described by Mr. Taylor as follows:

The selected material was put on in layers 6 ins. in thickness. The large lumps were previously broken and stones of more than 2 ins. diameter were thrown out. After each layer was in place it was cut with 12-in. garden spades in cuts not exceeding 1 in. in width. It was then cross-cut in the same manner.

The thickness of each layer after spading was about 4½ ins. This process of spading cut and cross-cut each layer twice.

When the clay puddle came in contact with the natural ground in the lowest parts of the foundation, and when the greatest care was exercised, pea gravel was mixed with the clay, from 15 to 25% of gravel being added. The size of the gravel used was from ¼ to ¾ ins. in diameter.

At the time the breach was made in the dam a pit was excavated in the natural ground from 15 to 30 ft. in depth, 63 ft. in width and 100 ft. in length (measured across the dam). This pit was cleared of debris in the reconstruction. The bottom of this pit was from 12 to 15 ft. below the bottom of the reservoir in the deepest place, and from 14 to 17 ft. below the bottom of the supply and waste pipes, which were laid in a masonry wall imbedded in the natural ground on one side of the pit. In this pit the width of the clay puddle wall was from 30 to 40 ft. on the bottom, or in contact with the natural ground. It also enveloped the pipe and the six cut-off walls on the sides and ends and was carried 1 ft. above the top. From this elevation, 35 ft. below the top of the embankment, and 31 ft. below the crest of the wasteway, the puddle wall was made a uniform thickness of 12 ft. The thickness of the wall below this elevation, except at the points mentioned, was 16 ft.

The part of the embankment above the heart-wall and also that below the natural surface below the heart-wall, was built of good material in 4 to 6-in. layers, rolled. Great care was taken to avoid pools of water or any excess of moisture previous to putting on a new layer. The upper slope was 2 to 1 and the lower, about 2¼ to 1. Mr. Taylor states that there is not now, after 17 years of use, the slightest indication of percolation through the embankment.

* See Eng. News, July 11, 1891; Aug. 18, Sept. 29, Nov. 10 and Dec. 22, 1892; and Jan. 26, Feb. 23, June 8, June 29, July 27, Sept. 28 and Oct. 19, 1893.

WATER PURIFICATION IN AMERICA.

Iron in the Artesian Water Supplies of Asbury Park and Ocean Grove, N. J.

(Continued from p. 8.)

The presence of an unusual amount of iron in the water supplies of both Asbury Park and Ocean Grove, N. J., has led to the employment by these two towns of Prof. T. M. Drown, of the Massachusetts Institute of Technology, to study their present supplies and possible new sources. As a considerable amount of iron in public water supplies is not general, the report of Professor Drown, in which he recommends a plan for removing the iron, is of much interest. The possible surface supplies contained more or less color, iron and vegetable organic matter and also large numbers of the organism crenothrix, an objectionable growth which has been known to clog pipes, although it may not be positively harmful from a sanitary point of view. The possibility of improving these supplies was not considered, as it was thought that after treatment the available supply from the deep wells would be better than the surface water.

The present supply of water at Asbury Park is from a large number of wells, some 400 to 630 ft. in depth. Professor Drown states that as it comes from the wells this water has a distinct unpleasant odor, resembling sulphureted hydrogen, probably caused by a mixture of carbureted hydrogens. The gases causing this odor quickly escape and do not impair the quality of the water. The water contains sufficient iron to cause a slight separation of iron oxide, but not enough to interfere with its general domestic use. Other conditions are on the whole favorable, but the supply is not sufficient.

Two deep wells have been sunk, one 1,020 and the other 1,045 ft. in depth, the water of which, though otherwise better than that from the wells described above, contains so much iron as to render it entirely unfit for domestic use, the average of metallic iron in both wells being 0.9121 part per 100,000.

Regarding this water and the possibility of removing the iron, Professor Drown says:

When the water is exposed to the air it quickly becomes clouded and in a short time a reddish-brown precipitate forms. This is due to the ferrous oxide in solution in the water becoming oxidized by the oxygen of the air, the ferric oxide thus formed being insoluble in water.

When the oxidation is complete the ferric oxide may be filtered out and the filtered water is permanently clear and colorless, and has very little iron remaining in solution. The process of oxidation may be hastened by various mechanical means, such as blowing air through it or exposing the water in thin layers to the air. I have tried a great many experiments in the laboratory as to the best and most rapid means of precipitating the iron in a form that it may be successfully filtered out through a layer of sand. I have been successful in removing the iron almost completely when filtering through rather coarse sand, at a vertical rate of 60 ins. an hour or of nearly 900 gallons per sq. ft. of filtering surface, and even a higher rate could be used successfully. The water thus treated by aeration and filtration contained only 0.02 parts per 100,000, less than half the amount contained in the present water supply.

I was informed when I visited Asbury Park that the quantity of water which these wells could supply would, of themselves, or in connection with the wells now in use, be ample for the supply of Asbury Park and Ocean Grove. This point should be first definitely settled by a prolonged pumping test. If the amount proves to be sufficient I am of the opinion that the iron can be removed by a mechanical treatment of the water with air, combined with subsequent sand filtration, at a moderate expense, and that a supply of water can be thus obtained which will be better than that now in use.

SEWAGE PURIFICATION IN AMERICA.

(Continued from p. 55.)

Sludge Disposal at Worcester, Mass.

Sludge disposal has been one of the most perplexing problems encountered at Worcester. Instead of installing sludge presses, filter beds were provided, onto which the sludge is pumped from the precipitating tanks. A portion of the moisture filters down through the beds and some of it evaporates, but both wet and cold weather interfere seriously with the process. When the sludge is dried as much as possible by this means, it still contains much water and its final disposition is yet a problem. Throwing it into heaps and covering it with earth has been tried with poor success. It burns readily enough in furnaces, and with a very reasonable fuel consumption, but the labor of handling it for burning is said to be too great. In the spring of 1892 the sludge which had accumulated since the previous September was put on private farm land, but the carting was done at the city's expense. From September, 1892, to the close of the fiscal year, Nov. 30, 1893, all, or nearly all, the sludge was removed by farmers at their own expense, with the exception of a few sample carloads shipped by the city to neighboring towns.

At first about three acres of sludge beds were provided. Later 5.7 acres were added, making a total of nearly nine acres, and it may be that the area is now still larger. The later beds are underdrained.

The sludge problem and its value as a fertilizer is very ably discussed by Mr. H. P. Eddy, Superintendent of Sewers, in his report for the year ending Nov. 30, 1893, from advance pages of which the following is taken:

Over 19.7 million gallons of sludge have been pumped from the settling basins since Dec. 1, 1892. This is equivalent to 97,000 cu. yds. or 82,000 net tons. Its composition is shown by the following analysis:

	P. c. of total.
Solids	2.88
Ash	1.90
Organic matter	0.98
Water	97.12

The sludge pumped constitutes about 1.1% of the entire volume of the sewage treated.

After remaining on the beds until dried out to 75% moisture the 82,000 tons would be reduced to 9,440 tons, and if this could still be further dried to 50% the amount remaining would weigh only 4,720 tons. Thus it may be seen what a large item the expense of hauling onto neighboring farms a small percentage of water is. Whether sludge may ultimately be disposed of as a fertilizer, or whether it is to be cremated, it is first necessary to reduce the amount of water contained in it to a minimum, if the work is to be done

economically. If the sludge has sufficient value its use as a fertilizer is undoubtedly the cheapest method of disposal.

By the following table of analyses (expressed in per-

Am. Soc. C. E., of Cincinnati, O., for use in his engineering practice; Mr. Hill states that they are more convenient for his purposes than the tables

TABLE I.—Annuity Required to Redeem 1,000 Dollars in From 1 to 50 Years.

Years to run.	Rate of interest, per cent. 2.	2¼.	2⅛.	2¾.	3.	3¼.	3⅛.	3⅜.	4.	4¼.	4⅛.	4⅜.	5.	5¼.	5⅛.	5⅜.	6.
2.....	495.05	491.50	493.78	493.23	492.69	492.05	491.42	490.81	490.20	489 60	492.00	488.40	487.80	487.21	486.62	486 02	485.43
3.....	326.72	325.94	325.14	324.35	323.56	322.75	321 94	321.13	320.36	319.57	318.77	317.99	317.22	316.42	315.63	314.87	314.10
4.....	242.63	241.74	240 84	239.93	239 02	238.11	237.26	236.38	235 50	234.72	233.74	232.84	231.95	231.12	230.29	229 45	228.60
5.....	192.16	191.18	190.24	189.30	188.35	187.42	186.49	185.56	184.63	183.71	182.79	181.88	180.98	180.05	179.13	178.26	177.39
6.....	158.53	157.53	156.56	155.58	154.61	153.64	152.67	151.73	150.79	149.83	148.88	147.95	147.02	146.10	145.18	144 27	143.36
7.....	134.52	133.51	132.49	131.50	130 51	129.54	128.57	127.59	126.61	125.64	124.67	123.74	122.82	121.89	120.96	120.04	119.13
8.....	116 51	115.48	114.47	113.46	112.46	111.47	110.48	109.50	108.53	107.56	106.60	105.66	104.72	103.79	102 86	101.94	101.03
9.....	102.52	101.48	100.46	99 45	98.44	97.44	96 44	95.46	94.49	93.53	92.57	91.63	90.69	89.76	88.83	87.92	87.02
10.....	91 33	90 29	89.25	88.24	87.24	86.24	85 24	84 26	83.29	82.33	81.38	80.44	79.50	78.58	77.57	76.77	75.87
11.....	82.18	81.14	80.11	79.09	78.07	77.08	76.09	75 12	74.15	73.20	72.25	71.32	70.39	69.48	68.57	67.68	66.79
12.....	74.56	73.52	72.49	71.47	70.46	69.47	68.48	67.51	66.55	65.61	64.67	63.75	62.83	61.93	61.03	60.15	59.28
13.....	68.12	67.08	66.05	65.04	64.03	63.05	62.06	61.10	60.14	59.20	58.27	57.36	56.45	55.56	54.68	53.82	52.96
14.....	62.69	61.56	60.54	59.53	58.53	57.55	56.57	55.62	54.67	53.74	52.82	51.92	51.02	50.15	49.28	48.43	47.58
15.....	57.83	56.79	55.77	54.77	53.77	52.79	51.82	50.88	49.94	49.02	48.11	47.22	46.34	45.48	44.62	43.79	42.96
16.....	53.65	52 62	51.60	50.60	49.61	48.64	47.68	46.70	45 82	44.91	44.01	43.14	42.27	41.42	40.58	39.13	38.95
17.....	49.97	48.94	47.93	46.94	45.95	44 99	44 04	43.12	42.20	41.31	40.42	39.56	38.70	37.87	37.04	36.24	35.44
18.....	46.70	45.67	44.67	43.69	42.71	41.76	40.82	39.90	38.99	38.11	37.24	36.39	35.54	34.73	33.92	33.15	32.36
19.....	43.78	42.76	41 76	40.78	39.81	38.87	37.94	37.04	36.14	35.27	34.40	33.57	32.75	31.95	31.15	30.85	29.62
20.....	41.15	40.14	39 14	38.18	37.22	36.29	35.36	34.47	33.58	32.72	31.87	31 06	30.24	29.46	28.68	27.93	27.18
25.....	31.22	30.24	29.27	28.35	27.43	26 55	25.67	24.84	24.01	23.22	22.44	21.69	20 95	20.25	19.55	18.89	18.23
30.....	24.65	24.70	22.78	21.90	21.02	20.19	19.37	18.60	17.83	17.11	16.39	15.72	15.05	14.42	13.80	13.22	12.65
35.....	20.00	19.09	18.20	17.37	16.54	15.77	15.00	14.29	13.58	12.92	12.27	11.67	11.07	10.92	9.97	9 47	8.97
40.....	16.55	15.68	14.84	14.05	13.26	12.54	11.83	11.17	10.52	9 93	9.34	8.81	8.28	7.80	7 32	6.89	6 46
45.....	13.91	13.07	12.27	11.52	10.78	10.12	9.45	8.85	8.26	7.73	7.20	6.73	6.26	5.85	5 43	5.06	4.70
50.....	11.82	11.02	10.26	9.56	8.87	8.25	7.63	7.09	6.56	6.07	5.60	5.19	4.78	4 42	4.06	3.75	3.44

centages) of horse manure. sludge and brewers' grain, a comparison of values may be obtained:

	Sludge. Wet.	Sludge. Dry.	Horse manure. Wet.	Horse manure. Dry.	Brewery grains. Wet.	Brewery grains. Dry.
Moisture	76.11	....	73.66	....	76.54	....
Nitrogen	.32	1.36	.61	2.32	.93	3.95
Total phosphoric acid	.30	1.25	.42	1.58	.26	1.11
Water, soluble acid	None	None	.14	.53	None	None
Citrate, soluble acid	.25	1.04	.28	1.05	.19	.80
Citrate, insoluble acid	.05	.21	None	None	.07	.31
Potash	....	....	.47	1.77	.02	.09
Valuation (relative)	1.36	5.76	2.88	7.89	3.20	13.57

Notes.—Brewers' grain, although generally used for feed, is frequently spread upon the land as a fertilizer.

Horse manure is comparatively a poor manure, but nevertheless many hundred loads are drawn from three to seven miles out of the city onto farms annually.

Valuations are made according to report of Massachusetts State Agricultural Experiment Station for 1892.

It is seen by the valuations affixed to the above table that the sludge as a fertilizer is worth half as much as the manure and one-third as much as the grain. Now it is a fact that both horse manure and grain are hauled long distances for the value they contain, and even as high as $2 a load is frequently paid for the manure; consequently it cannot be a mistake to assume that, at a moderate distance from the purification plant, the sludge is worth as much, if not more, than the grain or manure which is drawn several miles.

After the beginning of the treatment of the entire volume of sewage (July 15, 1893) the sludge increased rather faster than it was taken away, and during the coming winter, when the sludge simply accumulates, no drying being possible, the present filtration area will be worked to its utmost capacity. By June 1, 1894, this area will be completely utilized, consequently more land must be provided or some other method of disposal adopted.

By the present system of drying by filtration and evaporation little satisfaction is given. This method can only work in favorable weather. Rains may undo, in a few hours, what it has taken days of dry weather to accomplish. Many times sludge would be removed by farmers, but for the large amount of water contained in it. At the time when wanted, and even at any time, it is difficult to obtain that dried upon fields which contains less than 75% water and frequently that containing from 80% to 90% is hauled long distances. It is evident, then, that if the moisture be reduced to 50% the farmer will draw twice the value of fertilizing ingredients in one load; therefore, the problem of disposal is reduced 50%. as there is but half as much to get rid of.

In order to accomplish this result there is but one method now in existence which can be adopted economically, that of filter pressing; therefore, I would respectfully recommend to your committee that a plant for pressing this material be installed during the coming winter, that the future work of the department may not be handicapped by an enormous accumulation of sludge.

TABLES FOR CALCULATING SINKING FUNDS AND PRESENT VALUES.

Engineers and others connected with municipal work and various industrial enterprises often find it necessary to calculate payments to sinking funds which will provide a sum of money sufficient to pay off a bond issue or other debt at the end of a given period, or to determine the present value of certain annual charges. The accompanying tables were computed by Mr. John W. Hill, M.

used by insurance companies, and that he has checked them by such tables and independently, and found them to be correct.

Table I. shows the annual sum at various rates of interest required to net $1,000 in from 2 to 50 years, and Table II. shows the present value at various rates of interest of an annual charge of $1,000 for from 5 to 50 years, at five-year intervals and for 100 years.

The naval stability board reports the new gunboats "Machias" and "Castine" as being topheavy and unstable with their present armor. The board proposes that the two vessels be lengthened 14 ft. each by cutting the ships in halves, and estimates the cost of this operation at $30.000 for each ship.

PERSONALS.

Mr. P. E. Thian has been elected City Engineer of Everett, Wash.

Mr. William N. Eaton has been appointed Commissioner of Public Works of Chicago.

Mr. Eckley B. Coxe has been appointed a member of the Geological Survey Commission of Pennsylvania.

Mr. William A. Garrett has been appointed Superintendent of the Merchants' Bridge Terminal Co., of St. Louis.

TABLE II.—Capitalization of Annuity of $1,000 for From 5 to 100 Years.

Years.	Rate of interest, per cent. 2½.	3.	3⅛.	4.	4⅛.	5.	5⅛.	6.
5.....	4,645.88	4,579.60	4,514.92	4 451.68	4,389.91	4,329.41	4,268.09	4,212.40
10.....	8,752.17	8,530.13	8,316.45	8,110.74	7,912.67	7.721.69	7,537.54	7,360,19
15.....	12,381.41	11,937.80	11,517.23	11,118.06	10,739.42	10.379.53	10.037.48	9,712.30
20.....	15,589.215	14.877.27	14,212.12	13,590.21	13,007.88	12,462.13	11,950.26	11,469.96
25.....	18,424 67	17,413.01	16,481.28	15,621.93	14,828.12	14,093.86	13,413.82	12,783.38
30.....	20,930.59	19,600.21	18,391.85	17.291.86	16,288.77	15,372.36	14,533.63	13,764.85
35.....	23,145.31	21,487.04	20,000.43	18,664.37	17,460,89	16,374.36	15,390.48	14,488 65
40.....	25,103.53	23,114.36	21,354.83	19,792.65	18,401.49	17,159 01	16,044.92	15,046.31
45.....	26,833.15	24,518.49	22,495.23	20,719.89	19.156.24	17,773.90	16,547.65	15,455.85
50.....	28,362.48	25 729.58	23,455.21	21,482.08	19,761.93	18.255.86	16,931.97	15,761 87
100.....	35,614.21	31,508 81	27,655 36	24,504.96	21,949.21	19,847.90	18,095.83	16,612.64

Mr. George B. Prescott, M. Inst. Elec. E., author of several works on electrical subjects, died in New York city, Jan. 18, at the age of 64.

Mr. W. R. Woodward has been appointed General Manager of the Toronto, Hamilton & Buffalo Ry. Co., vice Mr. James N. Young resigned.

Mr. E. H. Keating, City Engineer of Toronto, Ont., has resigned his position, owing to the City Council having made a reduction in his salary.

Mr. C. C. F. Bent, Superintendent of Construction of the Baltimore & Ohio Southwestern R. R., has resigned. He was for some years General Superintendent of the Ohio & Mississippi Ry.

Mr. George W. Birdsall, Chief Engineer of the Department of Public Works, New York, who was recently appointed as a member of the Fourth Ave. Improvement Association, has resigned the latter position.

Mr. F. P. Reed has resigned his position as Chief Engineer of the St. Louis, Chicago & St. Paul R. R., to accept that of Chief Engineer of the Chicago, Paducah & Memphis R. R. The first position has been abolished.

Mr. Henry M. Rice, who died recently at San Antonio, Tex., at the age of 77, had been engaged several years ago in making surveys of Kalamazoo and Grand Rivers, Mich., and for a ship canal at the outlet of Lake Superior.

NEW PUBLICATIONS.

REPORT OF THE NEW YORK STATE RAILROAD COMMISSION. Vol. I., for the year 1893. Pub. Doc.; 8vo; cloth; pp. 720.

This first volume of the report is devoted as usual to the general report of the commissioners, the investigations, findings and recommendations of the commission, a summary of the laws affecting railway operations, etc. A pretty complete report of the accidents which happened during the year is given. From this we find that 742 persons were killed and 2,288 injured, a considerable increase over the numbers for 1892. Accidents and delays at grade crossings are increasing as the mileage of railway and population increase; 86 persons being killed and 112 injured at such crossings during 1893. The report calls attention to accidents due to collisions on electric and cable roads and makes a number of recommendations for the operation of such roads to avoid accidents. Here we are glad to note that the commission, while approving the use of fenders for street cars, state that "the use of some form of air-brake be considered by the managers of all electric and cable railroads. During the past year the board has made examinations as to the movements of street cars in the cities of the state, and is impressed with the benefits which might be derived from the use of some form of power brake by street railroad companies."

TRADE PUBLICATIONS.

TRACK TOOLS.—Verona Tool Works, Pittsburg, Pa. 4to; oblong; pp. 31.

This is a blueprint catalogue of cast steel crowbars, tamping picks, spike mauls and other track tools, the drawings being dimensioned and to scale. These works are specially well known as makers of the Verona spring nut locks, of which 201,015,199 had been sold up to Feb. 25, 1893.

SIGNAL AND INTERLOCKING PLANT.—McKenzie & Holland, Worcester, England. Oblong; 4to; pp. 48; illustrated.

This is a very handsome illustrated catalogue of signal appliances and interlocking plant, with views and plans of some of the large railway stations equipped by this company in England, Australia and India. One of the company's specialties is an interlocking apparatus in which the locking is effected by short arms on a rocking shaft operated by a journaled sector in which moves a lug on the operating lever. This arrangement is claimed to give much less wear than the ordinary arrangement of sliding surfaces, and to be superior to locking operated from the latch handle of the lever. Tappet locking apparatus is also manufactured. The Hawarden drawbridge (Eng. News, Sept. 15, 1892) is fitted with electric block and locking gear, the levers actuating the hydraulic valves of the locking bolts being controlled electrically from the block signal towers on either side. The telegraph wires are carried across the river between iron lattice posts 175 ft. high, made by this company. The semaphore blades are pivoted at the center to a bracket projecting from the post, and stand in a vertical position to indicate "track clear." The company has a large business on colonial railways and makes a specialty of economical plant for such service. It also owns the patents on the Wise train staff and tablet system (Eng. News, June 23, 1888) for working single track lines.

LUNDELL MOTORS AND DYNAMOS.—Pamph.; pp. 24. The Interior Conduit & Insulation Co., 44 Broad St., New York city.

The chief characteristic of the Lundell machines is the construction of the field magnet in such a manner that a single energizing coil magnetizes all the pole pieces and a strong protecting shell for the windings of both field and armature forms the magnetic circuit. The following are the percentages of efficiency guaranteed for motors of various sizes:

Size, K-W	0.5	1	2	3.5	5
P. c. efficiency	70	74	76	79	82

SOCIETY PROCEEDINGS.

OHIO INSTITUTE OF MINING ENGINEERS.—At the annual meeting at Columbus, O., officers were elected as follows: President, Edward Orton, Jr., Columbus; Vice-President, Daniel J. Harry; Secretary and Treasurer, R. M. Hazeltine.

IOWA SOCIETY OF CIVIL ENGINEERS AND SURVEYORS.—At the annual meeting at Cedar Rapids, Ia., Jan. 17 and 18, officers were elected as follows: President, William Steyh, Burlington; Vice-President, J. D. Wardle, Cedar Rapids; Secretary and Treasurer, Seth Dean, Glenwood; Directors, T. A. McDonald, Cedar Rapids, and M. Tschirgi, Dubuque.

Among the papers presented were the following: "Sewerage and Paving for Small Cities," B. Schreiner; "Cemeteries," Seth Dean; "Easement Curves," Professor Higgins, and "Sanitary Problems," M. Tschirgi. Reports were also made by special and standing committees. The membership is increasing.

ENGINEERS' SOCIETY OF WESTERN PENNSYLVANIA.—At the annual meeting held at Pittsburg, Jan. 16, Mr. M. J. Becker, the retiring president, made an address in regard to the urgent necessity of improving the water supply of that city, the impure condition of which is the cause of the high death rate from typhoid fever in Pittsburg and Allegheny. The secretary's report showed a membership of 473. The following officers were elected: President, Charles Davis; Vice-President, William G. Wilkins; Treasurer, A. E. Frost; Secretary, Daniel Carhart; Directors, Julian Kennedy and Thomas P. Roberts.

SCANDINAVIAN ENGINEERING SOCIETY.—At the meeting on Jan. 4 Mr. A. J. Roewad commenced a series of popular lectures on "City Architecture," which are to be published in book form.

The first lecture was merely introductory. The second lecture, delivered on Jan. 11, treated of the sanitary, practical and aesthetic principles of city architecture. The third lecture, delivered on Jan. 18, dealt with the elements of city plans, including the different kinds of streets, underground conduits, markets, harbors and waterways, railways, parks and public buildings, etc., followed by notes on building laws.

Howard Berge, Secy.

HARVARD ENGINEERING SOCIETY.—The students and instructors of Harvard University interested in engineering met Jan. 22 and completed an organization called the Harvard Engineering Society, the members of which are principally from the Lawrence Scientific School, but any member of the university who is interested in engineering is eligible to membership. The charter membership consists of six instructors, 30 students taking electrical engineering, 29 civil engineering, eight mechanical engineering and four architecture and mining engineering. The following officers were elected: President, Prof. I. N. Hollis; Secretary, A. N. Johnson; Treasurer, J. F. Vaughan.

ENGINEERS' CLUB OF MINNEAPOLIS.—At the annual meeting on Jan. 15 officers were elected as follows: President, F. W. Cappelen; Vice-President, J. M. Hazen; Secretary and Treasurer, Elbert Nexsen; Librarian, A. B. Coe; Member of the Board of Managers of the Associated Engineering Societies, W. A. Pike. After the business proceedings Mr. Andrews stated that he proposed to give the results of some radiator tests they had made, and propounded the following questions: (1) Whether the effort to base calculation and construction of radiators on a theory that the perfection of radiation made a perfect radiator is correct; (2) If the law of radiation should be that the heat is given off only in rays perpendicular to the surface of the radiator at every point, or that it is given off in every direction from each point? In answer to a question he stated that in a large flat house the expense of 75 cts. per sq. ft. of radiation per season had been obtained, and that in office buildings 1 sq. ft. of radiation would warm about 60 cu. ft. of space.

Elbert Nexsen, Secy.

ENGINEERS' CLUB OF ST. LOUIS.—At the meeting on Jan. 17 the following program for 1894 was announced: Jan. 3, "Street Railways," Winthrop Bartlett; Jan. 17, "Street Railways," Geo. R. Olshausen; Feb. 7, "Washington University Testing Laboratory," J. B. Johnson; Feb. 21, "Manchester Ship Canal," John Dean; March 7, "The New Water-Works; 1, General Features," M. L. Holman; March 21, "The New Water-Works; 2, The Extension," S. Bent Russell; April 4, "The New Water-Works; 3, New Machinery," J. A. Laird; April 18, "The New Water-Works; 4, Quality of the Supply," Robt. E. McMath; May 2, "The New Water-Works; 5, The Problem of Filtration," Robt. Moore; May 16, "Punching as a Means of Testing Structural Steel," Theodore L. Condron; Sept. 19, "Sharp Curves in Railway Yards," E. A. Hermann; Oct. 3, "Motions of Soaring Planes," Dr. C. M. Woodward; Oct. 17, "A Method of Determining Sewage Pollution of Water," Chas. C. Brown; Nov. 7, "Progress in Steam Engineering," Col. E. D. Meier; Nov. 21, "Report of Committee on Smoke Prevention," W. B. Potter, Chairman. Dec. 5, Annual Meeting; Dec. 19, Announcement of election. Address of retiring president.

Mr. Geo. R. Olshausen addressed the club on "Street Railways," dealing particularly with special work in track construction. He called attention to the great improvements which had been made in this direction in the last four years, and exhibited drawings of standard switch and crossing construction, and described a method of designing easement curves which he had found very satisfactory in practice. The form used was a spiral. The Union Depot Co. uses a rail weighing 100 lbs. per yd. on curves, and a 75-lb. rail for straight track. The necessity for a better form of brakes was discussed, the present types described and the practical experience with each stated. It was shown that what was needed was a quick and powerful application of the brake at first, while the car was still running fast. It was shown that if the rail was well bonded there was no necessity for supplemental return wires or other grounds. The electrolytic effect of the return current on water mains was explained, and it was thought this could be remedied by connecting the rails thoroughly to the pipes by copper wires.

Mr. Morrell, engineer of the Lindell Ry. Co., stated that in his opinion the best return was to weld each pair of rails together with two 0000 copper wires, and then connect the rails to the generators at the station without any other attempt at grounds.

Wm. H. Bryan, Secy.

MONTANA SOCIETY OF CIVIL ENGINEERS.—The annual meeting was held at Helena, Mont., Jan. 13. The secretary's report showed that there are now 39 active members, one honorary member and eight associate members. Mr. Haven, President, in an interesting address, said that he thought engineers keep themselves too much apart from other citizens, act as if their special knowledge was a trade secret, seldom take part in public discussions on works to be undertaken by states and municipalities, and yet wonder why the public does not appreciate their knowledge and work at their proper value. At the evening session Mr. John Herron presented a paper on "Repair Work in Railway Emergency Cases," in which he illustrated several temporary bridges used by him in washouts on the Montana Central R. R.

The society then entered upon a discussion of certain questions relating to the measurement of water under the state statute. It was generally conceded that the statute was very indefinite, and that different engineers could secure results varying at least 50% in the amount of water measured by employing different methods, all of which would comply with the wording of the statute. After the discussion lasting an hour, President A. M. Ryon, of the State College of Agriculture and Mechanic Arts, formerly Professor of Civil Engineering of the College of Montana, was appointed a committee of one to make experiments and to report to the society some more satisfactory method of measuring water than that provided for in the statute.

Mr. Goodale, Superintendent of the Gangon mine, at Butte, discussed the corrosion of iron pumps and iron pipe columns due to the presence of sulphuric acid in the water. One mine has a copper column, but copper is too expensive for general use, and brass has also been tried. He thought it probable that the best form of water column would be iron pipe lined with wood.

Officers were elected as follows: President, W. A. Haven; Vice-Presidents, J. S. Keeri and A. M. Ryon; Secretary and Librarian, G. O. Foss; Treasurer, A. S. Hovey; Trustee, W. S. Kelley; Member of the Board of Managers of the Association of Engineering Societies, J. S. Keeri.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—The annual meeting was held in New York, Jan. 17, Mr. Metcalf, President, in the chair; Mr. Collingwood, Secretary, and Gen. Geo. S. Greene, Past President, on the platform. The secretary read the reports of the Board of Directors, Treasurer, etc., abstracts of which are appended. The committee on award of the Norman Medal for 1893 announced that it had awarded it to Mr. Desmond FitzGerald for his paper on "Rainfall, Flow of Water and Storage." The committee on award of the Rowland prize announced that it had made its award to the paper by Capt. W. M. Black on "Improvements of Harbors on the South Atlantic Coast."

The report of the Committee on Information and Courtesy (which was appointed in view of the foreign engineers expected to visit the Columbian Exposition) was received and the committee discharged with the thanks of the society. The secretary presented letters from Mr. Sandford Fleming, chairman of the Committee on Uniform Standard Time, recording the progress made in the adoption of standard time and 24-hour notation in foreign countries. The Committee on Units of Measurement has, as yet, done no work, the members having had other matters to attend to, and a resolution was therefore passed to accept the resignations of the members and to authorize the Chair to appoint new members. The report of the Committee on Badges was accepted and the committee continued in order to make recommendations. The report showed a majority of the members answering the circulars to be in favor of a new design, but no design was recommended. The Committee on Uniform Tests of Material did not present any report. A proposed amendment to Article 3, Section 9, of the constitution was submitted, according to which a member who is expelled from the society could not, as now, escape expulsion by resigning. The vote was taken and the amendment was defeated. The decision as to time and site of the annual convention was left to the Board of Direction.

At the evening session the election of officers for the ensuing year was announced. The ballots amounted to the unusually high number of 920, of which 841 were found correct and counted. The point in the election lay in the contesting nominations for the office of secretary, which went in favor of the present incumbent and against the regular nominee by a vote of 501 to 339. The result of the election, with the number of votes cast for each officer, was as follows: President, William P. Craighill, Baltimore, Md., 837; Vice-Presidents, Joseph M. Wilson, Philadelphia, Pa., 814, and Charles C. Martin, Brooklyn, N. Y., 668; Directors, William H. Burr, New York, N. Y., 837; Bernard R. Green, Washington, D. C., 836; Joseph M. Knap, New York, N. Y., 834; T. Guilford Smith, Buffalo, N. Y., 834; Robert B. Stanton, Denver, Colo., 834; Henry D. Whitcomb, Richmond, Va., 835; Secretary, Francis Collingwood, Elizabeth, N. J., 501; Treasurer, John Bogart, New York, N. Y., 824.

Colonel Craighill made a few remarks in acknowledgment of his election, in which he referred to the desirability of more intimate connection between the army engineers and the civil engineers. Mr. Collingwood announced that in order to increase the interest of the Juniors in the affairs of the society he would present to the society a bond for $1,000, with $50 annual interest to be given as a prize for the best paper presented by a junior. On motion by Mr. Cohen the society gratefully accepted Mr. Collingwood's offer and a committee will be appointed to make the necessary arrangements. Mr. Wm. Metcalf referred to the present informal methods of presenting committee reports. Under the constitution the Board of Direction has no authority to regulate this. A resolution was passed providing that such reports must be in the hands of the secretary at least 30 days before the business meeting, so that they can be printed and sent out to the members of the committee and all members of the society for consideration. Mr. Metcalf also referred to the careful and thorough work of the Board of Direction in regard to investigating applications for membership and to other business of the society. After the close of the business meeting an interesting paper on "Cableways" was read by Mr. T. Spencer Miller, and was illustrated by stereopticon views of cableways, several of which have been illustrated and described in our columns.

On June 18 a large party proceeded by steamer to Sandy Hook, where, by the authority of Brigadier-General D. W. Flagler, Chief of Ordnance, U. S. A., and the courtesy of Capt. Frank Heath, U. S. A., commanding, they visited the new mortar batteries, the disappearing guns, etc., and witnessed the firing of a 10-in. shot through an 11-in. steel plate, and also the firing of an 8-in. rifle mounted on a disappearing carriage, and of a large mortar. The steamer started from the new pier of the American Line, at the foot of Fulton St., North River, which is built of steel and has cost about $300,000. In the evening there was a reception at the Society House.

The following is an abstract of the reports of the Board of Direction, the Auditor and the Treasurer:

The changes in membership are fully shown in the following table:

	Jan. 1, 1893.			Jan. 1, 1894.			Losses.			Additions.	Tr'ls.	
	Res.	Non res.	Total.	Res.	Non res.	Total.	Transfer.	Resign.	Dropped. Dead.	Transfer.	Election.	Loss. Gain.
Hon. mem....	6	2	8	6	3	9	.. .. ..		1	a 1	1	1 2
Cor. mem. ..	..	3	3	..	3	3	.. .. ..		..	..	..	.. ..
Membres.. .	194	940	1,134	208	964	1,172	1	6	13 13	b 6	65	33 51
Assoc. mem	20	89	109	37	109	146	4	1	.. 1	b 9	54	6 43
Associates..	27	47	68	21	47	68	..	2	1 1	..	3	4 3
Juniors.	74	164	38	80	173	253	15	7	4 1	..	42	27 42
Fellows.....	14	24	48	15	32	47	.. .. ..		2	..	1	2 1
Subscribers...	8	27	35	10	25	35	.. .. ..		..	..	..	.. ..
Totals.....	338	1,306	1,644	377	1,356	1,733	20	16	18 19		16	146 73 162

a, Member. b, Juniors.

It will be seen by the table that the net increase during the year has been 89. Applications for membership have been acted upon by the board during the year as follows: Passed to ballot as member, 70; passed to ballot as associate member, 48; elected honorary members, 2; elected associate, 1; elected juniors, 48; elected fellow, 1; total, 170; awaiting action, 24.

The losses by death during the year have been one honorary member, William C. Young; 13 members, Thomas Mutter Cleeman, Ernest Victor Clemens, Wendell Rhodes Curtis, Patrick John Flynn, Arthur Henshaw Howland, Charles Roberts Johnson, Augustus Woodbury Locke, Robert Kirkwood Martin, Joseph Dilwyn Potts, William Scherzer, David Lowber Smith, Cook Talcott, William Williams Walker; one associate member, William Watmough Thayer; one associate, Joseph W. Putnam; one junior, Alfred Burnham Ellsworth, and two fellows, Dennis Long and Frederick Aaron Lovecraft.

The expenditures upon the library for the past year have been as follows: Binding 68 volumes, $95.40; 12 books purchased, $41.60; contingent expenses, $27.52; total, $164.52. The additions to the library from all sources have been: Bound volumes, 167; unbound volumes, 182; pamphlets, 315; maps, 76; photographs and lithographs, 26; specifications, 141; total, 907. An ac-

cession book has been kept regularly, in which every addition to the library has been entered. The present number of books, pamphlets, etc., in the library is 17,886. In addition a large number of pamphlets and maps still remain to be catalogued and entered. Attention is again called to the fact that the growth of the library is largely dependent upon the legacies and contributions of reports and other engineering literature from members and from others who take an interest in the society's welfare.

The expenditures upon the Society House for repairs and betterments have amounted during the year to $202.19. The healthy life of the society is largely dependent upon the maintenance of general interest in its meetings, and this cannot be secured without adequate accommodations for the comfort of those who attend these meetings and take part in the discussions. The seating capacity of the room is only about 80. On many recent occasions the attendance has been over 100, and at times much greater. Non-resident members have been present in considerable numbers, and their visits to New York are often arranged so that they may attend the meetings. In the opinion of the board every practicable measure shouldbe taken to promote this feature of the society work.

The importance of securing larger accommodations in the near future cannot be over estimated. Moreover, the library space is rapidly being filled, and the desirability of a fireproof building for the security of the valuable books that are being rapidly accumulated is becoming more and more urgent. There is at present no convenient space for the arrangement and display of objects sent to the museum or for collections of photographs and plates. At the special request of many members the board has decided to open the rooms on every Wednesday evening during the first quarter of the year in order to afford opportunity for those who desire to consult the library and are unable to do so during the day. If the experiment proves a success it will be continued.

Nineteen numbers of the Bulletin were issued during the year, and 1,800 copies were printed of each number. Monthly numbers of the "Transactions" and "Proceedings" have been printed during the year 1893. Those from January to June, inclusive, contain the papers presented at the ordinary meetings, and the discussions received upon them, up to the summer vacation, together with all the convention proceedings; 2,200 copies were printed of each monthly number. This left the numbers for the last six months of the year free for the publication of the papers from the Engineering Congress; 2,500 of each have been printed, and as the matter has all been stereotyped, additional copies can be printed should they be required. The transactions comprised 1,971 papers, with 220 plates and 187 cuts. The proceedings covered 263 pages. The total cost of all publications amounted to $16,490.

In the last annual report the board gave a resume of the arrangements respecting the Congress, in so far as they were completed up to January, 1893. In response to the invitations to prepare papers for the Civil Engineering Division (of which the society had accepted charge) about 140 favorable replies were received. Those who promised papers were notified that, if possible, papers should be in the Secretary's hands by Jan. 15. Few papers were received before April, and some were not received until about the time of the meeting of the Congress. Fifty papers were accepted and presented, in printed form, to the Congress, containing 1,155 pages, with 129 plates and 70 cuts. These papers were furnished from the following countries: Germany, 16; Mexico, 4; Portugal, 3; Holland, 2; France, 2; England, 2; South America, 1; Nova Scotia, 1; Australia, 1; United States, 18; total, 50. A number of additional papers were received too late for presentation to the Congress, of which three have been published in the "Transactions." Papers written in a foreign language were translated by members of the society, effecting a large saving in expense, and securing the best results. The papers, together with the discussions, will make two large volumes. Bound copies will be sent to each society invited to participate in the Congress, and to each author who presented a paper.

There were registered in the Civil Engineering Division 207 members of the society, 76 visitors from the United States, and 65 foreign visitors and delegates, in all 348. The attendance at its meetings was large and the interest was well sustained.

A large number of foreign engineers were expected to pass through New York on their way to the World's Fair, and it seemed to the board desirable that something should be done to make them welcome, and aid them by giving information as to matters of engineering interest, and assisting them to obtain access to important works throughout the country.

Early in the year the board was informed, that contrary to what it had been led to expect, the World's Congress Auxiliary would have no funds available for the publication of papers. Voluntary subscriptions were therefore asked from the members for these two objects, and in response to the several circulars issued the sum of $8,716 was received. By deferring the publication of the papers read at the ordinary meetings during the last half of 1893, until the year 1894, this sum has enabled the board to meet the heavy expenses incurred in connection with the Congress. An additional amount of $3,000, requested from the society by the General Committee of the Engineering Societies for the purpose of maintaining an engineering headquarters at Chicago, was subscribed by members and paid to that committee. One company of foreign engineers visited this country in a body, comprising 48 members of the Societe des Ingenieurs Civils. They were entertained while in New York by representatives from each of the principal engineering societies. The expense was borne by the engineers of this country who visited Europe in 1889, as a return for the courtesies then received.

A Committee on Information and Courtesy, consisting of Messrs. Edward P. North, L. L. Buck and Foster Crowell, was appointed by the board to welcome visiting engineers and give them information. Acting under the resolution adopted at the last annual meeting, the Board of Direction, through a sub-committee, has canvassed the society for the purpose of ascertaining the views of all members on the subject of changing the badge of the society.

The question of the adoption by the society of a code of ethics came before the annual convention in a report from the Board of Direction, to which the subject was referred by the last annual meeting. The report presented arguments for and against the appointment of a committee on the subject, and was accompanied by a recommendation that such committee be not appointed. A resolution to refer the question of the appointment of a committee to letter ballot by the society was defeated by a vote of 11 in the affirmative and 54 in the negative.

During the year beginning Jan. 1, 1893, 21 meetings of the society (excluding the meetings of the Congress) have been held, one of which was the annual meeting in New York on Jan. 18 and 19, and one was the annual convention at Chicago. At these meetings 21 papers were read, and were discussed either orally or in writing by 133 members and others.

The Norman Medal for 1892 was awarded to William Starling, M. Am. Soc. C. E., for the paper on "Some Notes on the Holland Dikes." The Rowland Prize for 1892 was awarded to Samuel M. Rowe, M. Am. Soc. C. E.; Stillman W. Robinson, M. Am. Soc. C. E., and Henry H. Quimby, M. Am. Soc. C. E., for their paper on "The Red Rock Cantilever Bridge."

In closing this report the board takes great pleasure in congratulating the society on passing so successfully through this important year in its history without incurring debt.

The following is an abstract of the report of the Auditor for the year ending Dec. 31, 1893:

Receipts.

Balance on hand Dec. 31, 1892		$3,008.74
Entrance fees	$3,785.00	
Current dues	18,927.67	
Past dues	828.04	
Subscrip. for Engineering Congress	8,716.17	
Dues for year beginning Jan. 1, 1894	4,290.95	
Sales of publications	1,658.39	
Badges	515.00	
Certificates of membership	122.30	
Advertisements	2,279.50	
Interest on invest. bonds	1,066.12	
Compounding dues	250.00	
Fellowship fees	250.00	
Other sources	23.32	
		42,212.46
Total		$45,221.20

Disbursements.

Interest on mortgage	$800.00	
Taxes	418.60	
Stationery and printing	1,258.30	
Postage	2,161.13	
Publications	20,478.05	
Engineering Congress (excl. of Pubs.)	2,341.23	
Library	1,061.12	
Convention and annual meeting	1,663.17	
Janitor	720.00	
House supplies and furniture	210.62	
Fuel	268.78	
Water	17.00	
Gas	129.59	
Certificates of membership	105.99	
Badges	495.00	
Work of committees	296.34	
Safe deposit	16.00	
Norman Medal and Rowland Prize	122.45	
Finance and accounts	1,878.27	
Repairs and betterments, Society House	202.19	
Other expenditures	399.82	
Current business	6,033.42	
		$41,030.07
Balance		4,191.13
		$45,221.20

Report of the Treasurer.

Balance on hand Dec. 31, 1892	$3,008.74	
Receipts, Jan. 1 to Dec. 31, 1893	42,212.46	
Payments of audited vouchers, Jan. 1 to Dec. 31, 1893		$41,030.07
Balance on hand Dec. 31, 1893, in bank and trust company		4,191.13
	$45,221.20	$45,221.20

OHIO SOCIETY OF SURVEYORS AND CIVIL ENGINEERS.—The fifteenth annual meeting was held at the Hollenden, Cleveland, O., being opened Tuesday evening, Jan. 16, by addresses of welcome from Mr. Robert Blee, Mayor, and Mr. Walter P. Rice, Chief Engineer Department of Public Works. Mr. W. H. Searles, M. Am. Soc. C. E., read an interesting paper on "The Legal Status of the Civil Engineer." Wednesday morning was mainly taken up by reports of officers and committees. Mr. J. M. Harper, of the Committee on Legislation, showed that Ohio was very unfortunate in its legislation for engineers, and a new mittee was appointed for the purpose of collecting opinions from engineers as to what legislation was most needed to give a proper legal status to the profession. Mr. J. W. Holmes, of Batavia, N. Y., showed and described a very complete instrument for making observations, which might properly be called a solar transit theodolite. President J. B. Weddell delivered his address and Prof. W. R. Warner gave a lecture on "The Modern Observatory," illustrated by views of astronomical appliances from the ancient instruments of China to the Yerkes telescope for the Chicago University.

On Thursday morning Mr. G. R. Stattlemann, of Dayton, O., described a hoist bridge across the Miami River at that city. Mr. R. A. Bryan, Portsmouth, O., read a paper on "The Future of the Canal," in which, speaking of Ohio canals, he stated that they have a total mileage of 707 miles built at a cost of $15,967,850. Mr. W. B. Gerrish, City Engineer of Oberlin, O., described the separate system of sewers built in that town. The trunk sewer, consisting of 1,360 ft. of 8-in., 794 ft. of 10-in. and 8,650 ft. of 18-in. pipe, cost, complete, $8,160. A paper by Mr. F. M. Lillie, City Engineer of Youngstown, O., gave information of the pavements there. He found that Medina stone pavement cost $3 per yd.; asphalt, on a concrete base, $2.60, and a hard burned brick pavement on a base of 4 ins. of concrete, composed of 1 part Saylor's Portland cement to 3 parts sand and 7 parts broken limestone, the brick being laid on a sand cushion and grouted with 1 to 1 Portland cement mortar, cost $1.53 per yd. In the afternoon several committee reports were presented, and Mr. W. W. Kingsley, Superintendent of Cleveland Water-Works, described the building of the newer tunnel at Cleveland. On Thursday evening Mr. J. A. Hanlon, Coshocton, read a paper entitled "Some Phases of Railway Work." President Cady Staley, of the Case School of Applied Science, called the attention of surveyors to the necessity for more accuracy of measurements, and explained some of the ways by which accuracy could be attained. At the request of a number of members, Mr. F. P. Burt, of Engineering News, advanced arguments in favor of printing the more important papers beforehand and distributing copies to the members, so that they could come prepared to discuss them, and, by making it possible to omit the reading, to gain time for better discussion and for sightseeing. A committee on program was appointed with instructions to have such reports and papers printed and distributed at least four weeks before the next annual meeting.

On Friday the following papers were presented: "Demonstration of Technical Points in a Survey," by Mr. J. B. Weddell, Galion, O.; "Location of Boundaries and Streams," by H. M. Gates, Columbus, O.; "Standardizing of Steel Tapes," Mr. T. C. Mendenhall, U. S. Coast and Geodetic Survey. The next annual meeting is to be held at Cincinnati, O.

The following officers were elected for the ensuing year: President, J. M. Harper; Vice-President, Homer White; Secretary, C. A. Judson; Trustees, J. B. Davis, F. M. Lillie, H. M. Gates, C. S. Davis and F. M. Turner. The report of the secretary showed that there were 114 members on the roll, while a much larger number than usual were elected at this meeting.

COMING TECHNICAL MEETINGS.

ENGINEERS' CLUB OF MINNEAPOLIS.
Feb. 1. Secy., E. Nexsen, 504 Kasota Block.
ASSOCIATION OF CIVIL ENGINEERS OF DALLAS.
Feb. 2 Secy., E. K. Smoot, 803 Commerce St.
TECHNICAL SOCIETY OF THE PACIFIC COAST.
Feb. 2. Secy., O. Von Geldern, 719 Market St., San Francisco.
ENGINEERS' CLUB OF PHILADELPHIA.
Feb. 3. Secy., L. F. Rondinella, 1122 Girard St.
SWEDISH ENGINEERS' CLUB.
Feb. 3. Secy., P. Valentine. At 231 Union St., Brooklyn, and 646 North 10th St., Philadelphia. At 180 La Salle St., Chicago. Secy., John Ericson.
CIVIL ENGINEERS' SOCIETY OF ST. PAUL.
Feb. 5. Secy., C. L. Annan, City Engineer's Office.
ENGINEERS' SOCIETY OF PHŒNIXVILLE.
Feb. 6 Secy., W. Halliburton.
ENGINEERS' CLUB OF ST. LOUIS.
Feb. 7. Secy., Arthur Thacher, Odd Fellows' Bldg.
AMERICAN SOCIETY OF CIVIL ENGINEERS.
Feb 7. Secy., F. Collingwood, 127 East 23d St., New York.
WESTERN SOCIETY OF ENGINEERS.
Feb. 7. Secy., J. W. Weston, Lakeside Bldg., Chicago.
CANADIAN SOCIETY OF CIVIL ENGINEERS.
Feb. 8. Secy., C. H. McLeod, Montreal, P. Q.
ENGINEERING ASSOCIATION OF THE SOUTH.
Feb. 8. Secy., Hunter McDonald, Nashville, Tenn.
ENGINEERS' AND ARCHITS CLUB OF LOUISVILLE.
Feb 8. Secy., F. W. Mowbray, Norton Building.
NORTHWESTERN TRACK AND BRIDGE ASSO'N.
Feb. 9. Secy., D. W. Meeker, St. Paul.
MONTANA SOCIETY OF CIVIL ENGINEERS.
Feb. 10. Secy., G. O. Foss, Helena.
ENGINEERS' CLUB OF KANSAS CITY.
Feb. 12. Secy., Waterman Stone, Baird Building.
WISCONSIN POLYTECHNIC SOCIETY.
Feb. 12. Secy., M. F. Schinke, City Hall, Milwaukee.
AMERICAN INSTITUTE OF MINING ENGINEERS.
Feb. 12, 13. Virginia Beach, Va. Secy., R. W. Raymond, 13 Burling Slip, New York.
CIVIL ENGINEERS' CLUB OF CLEVELAND.
Feb. 13. Secy., F. C. Osborn, Case Library Building.
NORTHWEST RAILROAD CLUB.
Feb. 13. Secy., W. D. Crosman, Ryan Hotel, St. Paul.
NORTHWESTERN SOCIETY OF ENGINEERS.
Feb. 13. Secy., D. W. McMorris, Burke Block, Seattle Wash.
DENVER SOCIETY OF CIVIL ENGINEERS.
Feb. 13. Secy., F. E. King, Jacobson Block.
CIVIL ENGINEERS' ASSOCIATION OF KANSAS.
Feb. 14. Wichita, Kan.
NEW ENGLAND RAILROAD CLUB.
Feb. 14. Secy., F. M. Curtis, P. O. Box 1576, Boston.
AMERICAN SOC. OF MECHANICAL ENGINEERS.
Feb. 14. Secy., F. R. Hutton, 12 W. 31st St., New York.
ENGINEERS' CLUB OF CINCINNATI.
Feb. 15. J. F. Wilson, 24 W. 4th St.
NEW YORK RAILROAD CLUB.
Feb. 15. Secy., John A. Hill, Temple Court.
SCANDINAVIAN ENGINEERING SOC. OF CHICAGO.
Feb. 15. Secy., Howard Berge, 100 Washington St.
TACOMA SOC. OF ENGINEERS AND ARCHITECTS.
Feb. 16. 201 Washington Building.
ENGINEERS' SOC. OF WESTERN PENNSYLVANIA.
Feb. 20. Secy., R. H. Clark, Pittsburg.
WESTERN RAILWAY CLUB.
Feb. 20. Secy., Clement F. Street, Rookery, Chicago.
COLUMBIAN ENGINEERING SOCIETY.
Feb. 20. Secy., F. W. Hart, Washington, D. C.
ASSOCIATION OF ENGINEERS OF VIRGINIA.
Feb. 21. Secy., L. J. Carmalt, Roanoke, Va.
BOSTON SOCIETY OF CIVIL ENGINEERS.
Feb. 21. Secy., S. E. Tinkham, 36 Bromfield St.
CENTRAL RAILWAY CLUB.
March 28. Secy., S. W. Spear, Buffalo, N. Y.
AMERICAN RAILWAY ASSOCIATION.
April 11. Secy., W. F. Allen, 24 Park Place, New York
SOUTHERN & SOUTHWESTERN RAILWAY CLUB.
April 19. Secy., S. A. Charpiot, Macon, Ga.
MASTER CAR BUILDERS' ASSOCIATION.
June 12, 16. Saratoga, N. Y. Secy., J. W. Cloud, Rookery Building, Chicago.
MASTER MECHANICS' ASSOCIATION.
June 19, 23. Saratoga, N. Y. Secy., Angus Sinclair, Temple Court, New York.

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AND

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ADVERTISING RATES: 20 cents per line agate measure. Want notices, special rates, see page 22. Rates for standing advertisements sent on request. Changes of advertisements must be in hand on Monday afternoon; new advertisements, Tuesday afternoon; transient advertisements by Wednesday noon.

The committee on standard sizes for catalogues, specifications, etc., appointed at the last meeting of the Master Car Builders' Association, has made a report recommending the following standard sizes: Postal card circulars, $3\frac{3}{4} \times 6\frac{1}{8}$ ins.; pamphlets and trade catalogues, $3\frac{1}{2} \times 6$ ins., 6×9 ins. and 9×12 ins.; specifications and letter paper, $8\frac{1}{4} \times 10\frac{3}{4}$ ins. The matter of standard sizes for pamphlets and trade catalogues was discussed editorially in our issue of June 29, 1893. The 6×9-in. size appears to be the coming standard and its universal adoption is a much desired end. A library of catalogues classified by subjects is a great convenience. Any variation in size which hinders grouping the pamphlets on one subject in one case or compartment is a serious hindrance in arranging them for convenient reference.

Bills for submitting to a popular vote the question of consolidation into a Greater New York are now before the New York Legislature. Among the arguments advanced in favor of such consolidation are the following: Unless New York is increased in area by adding to it cities and towns which have been created by it, Chicago will soon outrank New York in population, at least, and the latter city will lose its old-time prestige. Chicago at its last special election for Mayor cast 227,350 votes, as compared with 238,220 votes cast at a general election in New York one month before. Chicago showed a register of 280,040 voters, or 20,000 more than New York ever registered. Chicago is growing very rapidly, and in matter of population is coming very close to New York as it now stands. In 1890 Chicago had 1,090,850 inhabitants, a growth in ten years of 593,685. But the proposed consolidation area of New York is also growing fast, as is shown by the fact that in 1890 New York, Kings County and Long Island City had a population of 2,633,279, a gain of 810,000 over the census of 1880. In our editorial of Jan. 11 this consolidation was advocated on broader grounds than those of mere competition with Chicago, and among these are the substantial and much-needed public improvements, bridges, tunnels, etc., which can only be secured when the interests favoring them are common, and not sectional, as at present. The chief opposition last year came from New York politicians, who, really fearing loss of political prestige, used an increased taxrate as a pretense for opposition. But it is now shown that such consolidation would temporarily raise the rate in New York from $1.82 to $1.92 per $100 and slightly reduce the Brooklyn rate; which latter is only just, as Brooklyn men doing business in New York now pay a large proportion of New York taxes. As to the question of increased area, that proposed by the Commission for the Greater New York is 125 sq. miles, as compared with 185½ sq. miles for the present Chicago, and 688 sq. miles for the Metropolis of London. Surely if these two cities can successfully handle the interests scattered over their areas, New York can adopt the smaller area noted with profit to all concerned.

The receipt of a series of 13 beautifully executed sheets in continuation of the topographical susvey of New York, which is carried on by the U. S. Geological Survey in co-operation with states which choose to do so, reminds us that we are already making fair progress toward that greatly to be desired end, a complete topographical map of our entire country. New Jersey led the van of all the states and its surface was completely and very beautifully mapped four or five years ago. Massachusetts, which has long had an accurate survey of its surface, leading all the states in that respect, is now being surveyed topographically in the same general style and under the same (U. S.) law as New York. New York has 1-13 of its surface, or thereabouts, covered by the 13 sheets before us, which also cover an area about half as great as the whole state of New Jersey. The Rocky Mountain district has already been pretty well mapped by the Geological Survey and our entire coast and most of our lakes and large rivers have been surveyed by the Coast or Lake Survey. The skeleton being thus formed and much flesh put on it also, it is probable that in a decade or two more all the more important districts will be accurately mapped and work in active progress on what remains undone, with a final completion of the vast work fairly in sight.

These sheets are about 13×18 miles in size, with contours 20 ft. apart, and every 100-ft. line shown heavier, and are printed in only three colors, black, sienna (for contours) and blue (in line) for water. The scale is 1-62,500, or about one mile per inch. The ground tint, which adds so much to the beauty of the New Jersey maps, is omitted, and with good reason, for one of the most important uses of these maps is to sell them at cost for a few cents per sheet and thus enable any one to make up any sort of a map he pleases, and draw or color on anything needed for his special purposes. Every person in the state may thus have, if he wants it, an accurate map for any desired distance around his residence at less cost than is usually charged for the rude and inaccurate county maps put out by private enterprise. But after the completion of these public maps such private publications also can all be accurate; and when to this is added the utility of the maps for projecting all sorts of public works the expediency of mapping all thickly settled regions as soon as possible is evident.

The "tidal wave" which struck the "Normannia" on Sunday last illustrates a truth which cannot be too carefully kept in mind in the design of lighthouses and other works along an ocean coast, viz., that at intervals of a few years or decades every spot on the ocean or coast is liable to be struck by a single wave many times larger and more violent than those which immediately precede and follow it. Every one who has crossed the ocean knows how rare it is for a large ocean liner to ship any serious amount of water on its hurricane deck, and the bridge is put still higher in order to be entirely safe. The "Normannia" is one of the finest ships running out of New York, being 520 ft. long, of 10,000 tons burden and 16,000 HP. Its bridge, if we remember correctly, stands nearly 40 ft. above the water. Yet without any preliminary warning it was boarded by a wave which must have been solid water to a somewhat greater height than the bridge, because it swept the hurricane deck almost clean, completely wrecking the officers' rooms and three large saloons on this deck, carrying away 14 ventilators and the starboard bulwarks and railings and flooding the decks below with 3 to 6 ft. of water, so that the captain deemed it necessary to put back for New York, although about one-third of the way over. All this indicates a wave of great severity and tremendous force, which can in no sense be "tidal," but must be formed by the chance aggregation of the energy of a number of waves into one by their happening to encounter each other in such a way as to make the transfer possible. The process in little can be watched on the horizon in any storm at sea, for at almost any moment there may be seen somewhere on the horizon some wave which leaps up far above any other in sight. The counterpart of this action is also frequently seen in storms, in the form of a limited area which is comparatively quiet, because the waves have chanced to counteract and destroy each other in some degree, turning their energy of motion into heat. When such minor effects can be seen continually, it stands to reason that at very long intervals exceptionally great ones should occur.

The veto by the President of the New York & New Jersey Bridge bill was a somewhat unexpected move, and there is much to be said on both sides, but that it is substantially just and proper must, we think, be admitted. The principal reason advanced, among several abstracted in another column, is the permission for a pier in the river. While it should by no means be laid down as a fixed principle that no pier is to be permitted in the river, it is certainly most desirable to avoid it, and the time has not yet come, in our opinion, if it ever comes, when conscientious legislators should tolerate any such proposition. That a single suspension span of 3,200 ft. or less is practicable no competent bridge engineer has questioned, to our knowledge. It is a simple question of expense. If this expense is shown to be so large as to be prohibitive, or to be more than the value of avoiding a pier in the river by any reasonable estimate, or to be a real impediment to the enterprise, then the pier should be conceded; but it should not be conceded until one or the other of these things has been affirmatively shown, and that any one of them either has been or can be shown seems to us very doubtful. It is to be remembered that any pier in the Hudson River must necessarily be very expensive if carried down to rock, because the rock lies very deep, while the mere cost of the bridge proper, whether with or without the pier in the river is only a small part of the total cost of the enterprise, including right of way, terminals, interest charges and so on. It is hardly likely that the total cost of the bridge proper will be more than one-third of this grand total, while it appears most improbable that the mere addition of a river pier would reduce the cost of the bridge proper more than 25%, which makes its effect upon the grand total only 8⅓%.

It is also to be remembered that the cost to the public of this or any such bridge is not affected at all by this difference, but only the profit of the constructing company. Whatever the cost of such a structure the invariable practice is to stock or bond it "for all it is worth," i. e., for its full earning capacity, or what the investing public can be made to believe this to be. The difference of this earning capacity or selling value and the actual cost is the builders' profit and theirs only. Now, a bridge across the North River is pretty sure to have a large earning capacity in any case, paying interest on a principal larger than its cost. Is it, therefore, necessary or proper, in order to increase the builders' profit in an enterprise of their own seeking, to load other public interests with a disadvantage for which there is no compensation? We do not see it so. When it becomes clear that no one will undertake to build a bridge without a pier, then and not until then, does it become proper to concede the pier.

Scientific forestry has made a beginning in the United States on the 100,000-acre estate of Mr. George W. Vanderbilt, in North Carolina. Mr. Gifford Pinchot, the first American to graduate from a school of forestry, is the consulting forester, and he has recently published a pamphlet showing the progress made in the Biltmore Forest, which contains 3,891 acres. A topographical survey has divided this area into squares of 500 ft. and the dense native forest of young oak, chestnut, hickory, maple, tulip and pine trees is being systematically thinned out with a view to general improvement and profit to the owner. Trees to be felled are carefully selected and the young growth as carefully protected from cattle, fire and injury from the felling of larger trees. All tops and branches are cut into firewood or corded for the making of wood alcohol. The plan proposed will ultimately provide for a crop of timber in some part of the forest ready for cutting each year, while the other parts are maturing; thus reducing forestry to a regular and steady business and providing against wasteful cutting. This is the first practical application of forest management in the United States; and it comes none too soon, according to the reports of the U. S. Forestry Division of the Department of Agriculture, upon the original neglect and waste which now characterize our treatment of the American timber supply.

The election of secretary in the American Society of Civil Engineers has resulted as we predicted. By a vote of 501 to 339 Mr. Collingwood is continued in the office for another year at least. What the motives of the voters were one can only surmise; but in most cases it doubtless lay in the same issues which induced us to express an opinion on the subject; those, namely, of policy and propriety rather than in any issue as to the relative qualifications of the candidates as individuals. The defeated candidate should accept the result in this impersonal sense, and not as in any degree a judgment between two individuals, for this, we believe, is the view which decided a large majority of the votes cast. But we shall be disappointed if this election does not have the further result of revealing to a majority of the voters the error and absurdity of choosing the secretary at all by popular vote. The secretary of such a society, if it is to be well managed, is simply the salaried servant and executive arm of the board of direction, and he should be in law what he is in fact. The board alone knows how efficient he is and it alone has any real opportunity to learn his strong and weak points. Each member of it is directly interested in insuring his efficiency, besides having the best chance to judge of it. What does the outside member who is not a member of the board know of the actual efficiency of the secretary? Unless by some accident, nothing whatever. If only those had been allowed to vote for secretary in the late election who had some accurate knowledge of the relative qualifications of the two candidates not a tenth of those who voted could have voted at all, and possibly not a corporal's guard outside of the board of direction. In this case, however, the issue properly turned on a collateral issue in which the average voter was qualified to express an opinion, so that substantial justice was done; but the point is that, had the mode of choice for the office been what it should be, the issue never could have arisen at all. The board of direction, if the power were once put in its hands, might be confidently relied upon to insist upon efficiency in the office of secretary as the first and last essential, and what is more, when it saw or suspected that a change was necessary, it might be confidently relied upon to go about the work of making it cautiously and deliberately, as it easily could, being a continuous body, quietly scrutinizing all possible candidates before making a choice. The nominating committee, while a very suitable agent for nominating new members of the board of direction, is wretchedly ill adapted to choose a permanent salaried officer, since it is not only possible but certain that it must act quickly if at all, and without the advantage of prior intimate knowledge of the society's business. Consequently, with the best of intentions, it is always liable to make a mess of its work.

While speaking of this feature of the Am. Soc. C. E. constitution, perhaps it may be well for us to refer briefly to another matter intimately affecting the society's credit, if not its welfare. It is quite possible that an effort may soon be made to amend the society's constitution in respect to the office of secretary, and perhaps in some other matters of like nature. If so, it is greatly to be desired that there should be an accompanying effort to correct and improve the verbal form of that instrument, so as to express the same provisions in fewer and better words. The committee which framed it was evidently more concerned with the substance than the form, or else it did not happen to include any one critical in such matters; for we know of no other formal document which is so justly objectionable in respect to use and misuse of words. To mention first a trifling defect of a kind which abounds. In the very first article it declares of the society that "its objects" shall be (three things named), and then goes on to say that "for this purpose" there shall be—meetings, etc., etc. What purpose? No one purpose has been stated, but three. In both sentences alike it would have been legitimate to refer to the society's "objects" in the plural, or "purpose" in the singular, but it is not good English to use one in one line and the other in the next line.

In the next article we have an amusing case of a completely redundant section. Sections 2 and 3 define in detail the requirements for member and associate member, among which are that the candidate "shall have been in the active practice of his profession ten (and six) years." The very next section (4) goes on to say: "Any person having the qualifications prescribed for admission shall be eligible for membership, though he may not be"—it matters not what. What it actually says is, "though he may not be practicing his profession at the time of making application"; but it would be neither more nor less pertinent if it went on to say, "or though he may not have red hair," or a second wife, or any other conceivable qualification which the constitution does not ask for. It is plainly absurd to specify, first, in two carefully worded sections just what qualifications a candidate must have, and then add another to say that candidates having them shall be eligible though they may have something else not asked for.

In the second section of the next article there is another kind of defective form which makes the letter of a sentence demand the very thing which its spirit aims to avoid, viz., perfunctory indorsement of a candidate by the five members to whom he elects to refer for a "character." By the letter of the constitution these five members "shall each be requested by the secretary to forward a letter certifying that he knows the applicant and believes him to be a proper person to be admitted to the society"! The meaning is plain, but the letter is also plain, and to a contrary effect. As an instance of the omissions of the constitution this same section does not say, what is the undoubted intent and practice, that favorable responses must be received from all or any of these references to make a candidate eligible.

So we might go on with many more instances of defective form, most of them, of course, not so bad nor so clear as this; but Sec. 10, of Art. IV., for example, is another one, every word of which is superfluous. Its apparent object can be attained by a slight change in another section which shortens it. At a guess, any one using words at all carefully and studying form only might express every intended enactment of the constitution in from one-third to two-thirds as many words, with some which have been intended, but not stated, and with a decided gain in clearness. If any one would see how, let him read over consecutively, first, the old "Articles of Confederation and Perpetual Union" of the United States, which is in bad and verbose English; secondly, the Constitution of the United States, which is one of the most perfect specimens of English composition ever written; and, thirdly, the constitution of the Am. Soc. C. E. He will see at once that the style of the latter resembles the Articles of Confederation and not at all that of the Constitution.

FREE WATER.

The abolition of all water taxes, except those paid by companies and institutions which pay no city taxes, and the raising by general taxation of all money required to meet the operating expenses of the city water-works, is a scheme strongly advocated by the Hon. Hazen S. Pingree, Mayor of Detroit, in his recent annual message. As this proposition is made in good faith by a man who in his official capacity has done much for his city and as it is at variance with long-established practice throughout the United States it is worth while to examine in detail the mayor's plan and his arguments in favor of it, both of which are presented at some length in his message.

He first states that no other city in the Union is so favorably situated as Detroit with respect to water supply, a great river, "whose limpid purity is unexcelled," flowing close by. An injustice and lack of wisdom in the assessment of water rates and use of meters is next alleged, as follows:

> Yet with this prodigality of nature, in that without which life itself cannot be sustained, which ought to be here of all places, next to the air we breathe, free, we find a scheme in vogue of measuring it out by the drop to consumers. Manufactories are the life-blood of our community. They cannot get along without water; the more they use the more business they do, the more help they employ and the more they expend in wages which goes into the channels of trade in our midst. Yet all the water they use must go through a meter and every gallon must be paid for or the wheels of industry must stop. The widow who rents one room in an upper story pays the family rate for water—$5 per year. Some of my luxurious friends on Woodward and Jefferson Aves. run as many as five sets of hose on their magnificent lawns all summer and pay nothing. I mention these instances to show the inequality of the burden, the injustice of the assessment of cost. We should either have a meter for every one who uses water or have none at all.

It is then claimed that four out of five dollars of the water rate paid by a family in the settled portion of the city is used "to lay pipes in front of someone's vacant land out in the woods, so that it can be sold for fabulous prices," and a plan intended to be more equitable is propounded and its advantages set forth in the following language:

> (1) Abolish water rates, except to railroad companies and other institutions which, under the present law, are exempt from city taxation.
>
> (2) Put in the annual budget for a general tax a sufficient sum to pay for the actual pumping of water, and probably for the construction of a main pipe where such may be necessary to supply a whole district.
>
> (3) Cut off the army of water assessors, collectors, meter-readers and repairers and men who go around and shut off the water because of some dispute between landlord and tenant as to who shall pay. This would effect a saving of $25,000 or $30,000 a year.
>
> (4) Where water pipes are extended into new territory let the abutting property pay the expense, the same as it does when a street is paved or otherwise improved.
>
> (5) Take out all the meters and sell them for what they will bring. They were a bad investment in the first place, and, though $75,000 of the water consumers' good money is now tied up in them, it is no reason why more should be sent after it.
>
> (6) Then let the water board turn over to the city proper its $8,000,000 worth of property and thereafter have a common treasury and a common interest with the rest of the people of Detroit.
>
> The adoption of this plan would make Detroit practically a city of free water, as it ought to be. It would be a great inducement to manufacturers to locate here, and a substantial encouragement to those already in business here. The actual cost of supplying water is so small that the burden, distributed over all the taxable property in the city, would not be felt by any one, providing that the cost of extensions was paid for by the property benefited.

Whether or not the Detroit Water Board shows discrimination in its schedule of rates, which are quite low, especially the meter rates, and whether the water-works should be held in common with the other city propery, are matters of local interest principally. But there are other questions in connection with Mayor Pingree's proposition which are of general interest. Thus: (1) Would it be wise to furnish water to all except non (local) taxpayers without charge, save that included in the general tax levy; and (2) even if this were wise, could meters and inspectors both be done away with so readily as the mayor proposes without an enormous water consumption or waste resulting?

But before discussing these questions the allegations regarding the proportion of revenue which goes into pipe extensions for the benefit of real estate speculators should be considered, for the

figures in this connection are almost the only ones presented which indicate that the broad financial aspects of the case have been given such consideration as they deserve and if these figures are at fault the mayor's plan appears to be largely based upon generalities. In addition the analysis which follows may show how much money must be raised from some source to carry on and extend the works and whether the consumption must not be kept down, at least to its present level, even if all water rates should be abolished.

As stated above, the mayor claims that $4 of the $5, the latter being the minimum water rental in Detroit, paid by a family for water in the settled portion of the city goes for pipe extensions in "the woods." The latest report of the Detroit Water Board at hand is that for 1892, when only 45% of the revenue from consumers went into pipe extensions, while in 1888 only 44%, and in 1882 but 31% was so expended. These percentages include all money for pipe extensions, whether located in "the woods" or the center of the city. From these and other figures we conclude that the mayor's statements were very hastily made, but still the general principle remains that some portion of the consumers' money went into pipe extensions. But if this is objected to the same objections, at least in part, may be made to the expenditure for construction of any of the money derived from water rates, for some of this money must benefit such extreme outlying districts as have water mains. The fairer question to raise would perhaps be, should any of the revenue from water rates be applied to new construction? Let us first see what percentage of the total receipts is from water rates, what derived from general taxation and what from miscellaneous sources and also how the expenditures are divided between construction, operation and interest charges. The last bonds were issued in 1881 and since that year, or beginning with 1882, all the expenditures have been met from earnings or from the yearly tax levy. In 1888 the water consumption and the operating expenses reached their highest point and 1892 is the latest year for which figures are available. Therefore we will consider the total receipts of the Detroit water-works for the years 1882, 1888 and 1892.

Receipts and Expenditures of Detroit Water-Works for the Years 1882, 1888 and 1892.

	1882.		1888.		1892.	
Receipts:	Am't.	P. c.	Am't.	P. c.	Am't.	P. c.
Water rates	$266,721	76	$349,702	80	$408,851	80
Taxes	75,457	21	70,024	16	74,484	15
Miscellaneous	10,739	3	16,770	4	26,025	5
Total	$352,917	100	$436,496	100	$509,360	100
Expenditures:						
Construction	$122,112	44	$178,628	49	$250,696	59
Operation	49,060	17	101,019	28	99,562	23
Interest	106,260	39	85,560	23	76,905	18
Total	$277,432	100	$365,207	100	$426,063	100
Surplus	75,485	...	71,289	...	83,297	...

The accompanying table shows that 76% of the receipts in 1882 and 80% in both 1888 and 1892 were from the water rates and 21, 16 and 15%, respectively, from the general tax levy. Construction made up 44% of the expenditures in 1882, 49% in 1888 and 59% in 1892. In 1888 operation cost relatively more than in either 1882 or 1892, owing to the enormous waste of water at that time. Interest has been gradually decreasing, thanks to the fact that the revenue has been sufficient to redeem some of the bonds. Each year there has been a surplus, almost identical in the first two years and greater in 1892 than the receipts from taxation. The operating expenses and interest charges in 1892 were 41% of the total expenditures and about 43% of the revenue from water rents alone.

The interest charges represent only the interest on outstanding bonds, $1,299,000 in 1892, mostly at 7% interest, there having been $200,000 at 6 and $250,000 at 4% interest.

The valuation of the works at the close of 1892, as made by the several heads of departments, was as follows:

Office building and lot	$60,000*
Three lots, Orleans St.	41,250*
Reservoir grounds and improvements thereon.	47,200*
Oil pumping station	14,619
Grounds at new pumping works	250,000*
Buildings, docks, basin, conduits, etc.	752,878
Water pipe laid and in use	2,904,850
Meters placed and in use	68,734
Tools and materials on hand	60,100
Total	4,298,661

* Of increasing value, aggregating $398,450.

That these estimates would not be considered too high by Mayor Pingree is evident from Proposition 6 of his plan, given above, in which he values the property at $8,000,000. Deducting from the total valuation above $398,450, the value of real estate, there remains $3,900,000 subject to varying rates of depreciation which can hardly average less than 2% per annum, at which rate the total depreciation would be $78,000. All of the outstanding bonds fall due before the close of 1906, or in 13 years, requiring about $100,000 per year for this purpose.

Therefore a business man would figure that he must have from some source for his next fiscal year the following sums:

For operation	$100,000
For interest	76,000
For depreciation	78,000
For redemption of bonds	100,000
Total	$354,000

In addition to these charges some money must be spent for extensions into new territory and consequent enlargement of plant in other respects. The total revenue from consumers in 1892 was $409,000, so there remains from this source only $55,000 for extensions. The miscellaneous revenues raise this sum to about $80,000, and the amount available for a year's extensions and enlargements (not renewals or repairs) is only brought up to $155,000 by the $75,000 from the general tax levy, which latter certainly is not an extravagant sum to be contributed for water furnished to the 2,292 fire hydrants and 479 reservoirs in use at the close of 1892.

As a matter of fact the 1892 construction account was $250,000, instead of $155,000, but the proposed $78,000 was not set aside for depreciation, going into construction instead. The surplus $83,000, in 1892, somewhat less than the yearly allowance for retiring bonds, was actually designed, together with a balance from the previous year, to redeem $146,000 of bonds which fell due in August, 1893. All of which indicates that the money raised in 1892 from the three sources, water rates, taxes and miscellaneous, was required for legitimate expenses, as the works are now operated. And we may add at this point that the reports of the Detroit Water Board indicate that its works are admirably managed, either from an abstract point of view, or as compared with other cities—except that an enormous water consumption remains even after five years of reduction, a consumption which undoubtedly could be much further reduced without causing injustice or even great inconvenience to any one, but only by stringent measures to prevent wanton waste, to which Mayor Pingree is firmly opposed.

Having reached the point where it is evident that an even half million or so of dollars a year are required to carry on the Detroit water-works, nearly $300,000 of which is for operation, interest and depreciation alone, we can realize the utter sentimentality of the idea that water should be as free as air, even when plenty of it is close at hand for pumping, and consider calmly how this amount may be raised with the least friction and injustice. And first, it may be said that since it costs money to build and operate works to supply water, and since the cost of this service is accurately known, it seems fitting that every one should pay for just the amount of water they use or waste, provided that: (1) It is not expedient for the community at large to pay that part of the expenses of manufacturing establishments which is represented by the water they consume in order to induce manufacturers to come to or remain in the community, a question which we must leave to the decision of economists and taxpayers; and (2) that the cost of building and operating works will be more justly distributed if met by general taxation than if paid by each consumer according to value received, as is coal, sugar or cloth, or any other of the commodities necessary to carry on a business enterprise or a household. It is doubtful whether any one who has made a careful study of water consumption and waste would for a moment urge that it is more just to meet the expenses of a water supply system by general taxation than by the revenue derived from the sale of water on business principles. There is no certainty, and perhaps little probability, that the use of water will be in any degree proportional to the amount contributed by the consumer to the general tax fund. If water-works are properly managed, both as to operation and assessment of rates, there seems to be no reason why a liberal amount of water cannot be furnished at a price within the means of every family not already the object of public charity, which removes all reason for abolishing water rentals on the ground of public health. At present there undoubtedly exist in most cities many inequalities in water rates, but these are largely due to the haphazard manner in which the rates are assessed and the fact that when an effort is made to charge according to the actual amount of water used, still retaining a yearly charge, the consumption of various classes of consumers is too often guessed at instead of measured and, even when measured once, allowance cannot be made for the amount of waste through carelessness or leaky fixtures.

But, supposing all water rates were abolished, would not stringent measures to prevent waste still be necessary? There seems to be no doubt of it, for the abolition of rates would certainly not tend to make the majority of consumers less wasteful than now and practically all water-works officials believe that waste prevention is an absolute necessity, as was very clearly shown by the article in our last issue on "Water Waste Prevention or Increased Pumping Capacity." The concluding part of this article, printed in this issue, relates wholly to studies of waste made at Evanston, Ill., by Mr. Henry S. Maddock, Commissioner of Public Works in that city. Mr. Maddock believes that it is far preferable in his city to reduce consumption and waste than to buy new pumps and put in larger mains, which is the present alternative. Curiously enough, at almost the same time that the Mayor of Detroit was preparing his message in which he states, as quoted above, that the meters in use in Detroit are a bad investment and should be sold for what they will bring, Mr. Maddock was fortifying his position in favor of the meter system by references to its success in Detroit. Just what has been done by means of meters in Detroit was shown at length in our issue of Feb. 16, 1893, from which we reprint the following paragraph:

> Some very important and interesting figures, having a direct bearing upon the proper management of many water-works, have just been made public from Detroit. An average daily consumption of 204 gallons of water per capita in 1888 so taxed the capacity of the water-works that an enlargement of the system seemed imperative It was found that the necessary improvements would cost $600,000, and in view of the already extremely high consumption the water commissioners very wisely resolved to try the effect of meters before enlarging the works, an expedient far too rare in this country The success of this measure is shown by the fact that the total consumption of water in Detroit in 1892 was nearly two billion gallons less than in 1888, notwithstanding an estimated increase of population of 46,000, while the total operating expenses were $2,251 less in 1892 than in 1888 The number of meters in use increased from 48 in 1888 to 2,053 in 1892, the percentage of water metered from 0.67 to 13% of the total pumpage, while the average daily consumption fell from 204 to 140 gallons per capita, the intermediate steps having been 172 gallons in 1889, 155 in 1890 and 144 in 1891. At the close of 1892 practically all the manufacturing and business interests of the city were supplied through meters.

Even this consumption of 140 gallons per capita in Detroit seems far above legitimate demands, and if so should be still further reduced. How can it be reduced, or even kept from mounting up again, save by inspection and the use of meters, both of which Mayor Pingree wishes to abolish? And if no water rates are charged, of what use will inspection or meters be, for then the yearly rentals for unmetered premises cannot be increased and where meters are used they only tell of waste, but do not increase a consumer's general taxes, if he happens to be a taxpayer. Only two causes would be open, cutting off the water or a system of fines. Which of these would the mayor adopt? Of course he would adopt neither, according to his message, for the Detroit River would still be at hand to pump from and he would add pump to pump and put in larger and larger distributing pipes. But the time might soon come when the taxpayers would rebel at their increasing taxes, every one swearing that not he, but his neighbor, was wasting water and demanding that the waste be stopped.

LETTERS TO THE EDITOR.

THE SLIDE RULE—A SOUND SUGGESTION.

Sir: The slide rule has proved itself such a useful little instrument that any suggested improvement will be of interest to those who use it. Inclosed herewith is a sketch of the left end of my rule with the slide removed.

The principal thing shown is the spring "A," Fig. 1, an edgewise view of the spring being shown in Fig. 2. The difficulty usually encountered is the fact that the slide seldom can be made to move easily and smoothly. It is also greatly affected by changes in temperature. To overcome this I carefully fi'ed the slide till it worked freely, then cut back the groove and set the spring under the "A" scale as shown. A

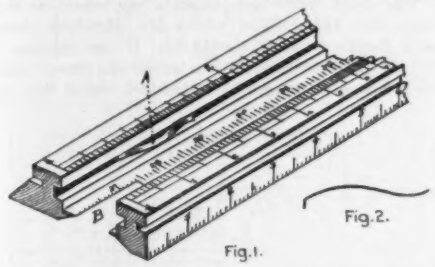


Fig.1.

Fig.2.

similar spring is also placed at the right end. These give the slide a smooth even motion, not otherwise to be obtained. The springs are made out of a piece of steel tape.

Another difference will be seen in the notch "B," Fig. 1, which is exactly similar to the one at the right end of the ordinary rule, and the reverse side is marked in the same way. It thus becomes possible to read logarithms and natural sines with the slide stand-to the left, which is often very desirable.

These two changes I have found to greatly increase the usefulness of the slide rule.

Very truly, Walter C. Parmley,
Asst. City Engineer.

Peoria, Ill., Dec. 1, 1893.

(We commend these suggestions to the attention of makers as well worth adoption. The sticking of slide rules, or the reverse effect of too great looseness, is a real annoyance, and doubtless a principal reason why they are not more used.—Ed.)

ECCENTRIC LOADING OF RIVETED WORK.

Sir: The conclusion reached by Mr. Moses in his interesting communication, published in your issue of Jan. 11, that "the angle is stronger with two holes out than with one," is indeed a remarkable one. The force of the argument lies in the assumption that the stresses are uniformly distributed through the full section of the angle on both sides of the hole, and also through the net section at the hole. While the assumption is general, the conclusions reached invites us to examine the case more critically, and I would submit, that in the first place the actual distribution of stress will practically depend upon the manner in which the angle is connected in the vicinity of the hole, and angles are usually fastened by one leg only; next upon the quality of the materia', and finally, that the stresses, even if uniformly distributed on both sides of a rivet hole, would, in passing the hole, concentrate at the edges of it, rather than distribute uniformly over the reduced section. The.e would, in this case, therefore, not be any resultant eccentricity, and we would not have to resort to the punching of another hole in the opposite leg in order to restore equilibrium.

The suggestion contained in the communication is, however, a very important one. It has, for instance, a bearing upon angles with unequal legs which has not received general attention and discussion. I fully concur with Mr. Moses in urging that actual tests be made, particularly to ascertain, if possible, how the stresses are distributed.

Respectfully, O. J. Marstrand, C. E.

New York, N. Y., Jan. 15, 1894.

BLOCK SIGNALS ON THE NEW YORK, NEW HAVEN & HARTFORD R. R.

Sir: In your issue of Jan. 18 it is stated that "With the possible exception of the New York, New Haven & Hartford, there is no company handling so large a suburban traffic as the Lackawanna out of New York city without the protection of block signals."

Permit me to draw your attention to the fact that the New Haven road is equipped throughout the whole Shore Line with the Sykes system of blocking. In fact, the trains of this company are under the protection of the Sykes system when they leave New York, as the Fourth Avenue tunnel is also equipped with the Sykes system. Arthur H. Johnson.

New York, Jan. 19, 1894.

PROFESSOR DURAND'S NEW RULE FOR INTEGRATION.

Sir: Professor Durand's new rule for approximate integration is no doubt a good one, but your editorial modification of it, viz., Determine the mean ordinate by the old rough rule, then add to it algebraically to (half sum of first and last minus half sum of the penultimates) seems to contain an error. In the first place, it is not the mean ordinate that is determined by the trapezoidal rule as you give it, viz., sum of the ordinates minus half the sum of the first and last. The mean ordinate is this quantity divided by the number of spaces. Secondly, Durand's rule gives for coefficients of the ordinates:

Durand.....	.4	1.1	1	1	.....	1	1	1.1	.4
Trapezoidal....	.5	1.	1	1	.....	1	1	1.	.5
Difference....	−.1	+.1						+.1	−.1

$= \frac{1}{10}$ (sum of penultimates − sum of first and last)

instead of

$$\frac{1}{10}\left(\frac{\text{sum of first and last}}{2} - \frac{\text{sum of penultimates}}{2}\right).$$

Yours truly, Wm. Kent.

New York, Jan. 19, 1894.

(Our correspondent's correction is correct. What we should have said was this: Determine the sum of the ordinates (not the mean ordinate) by the old rough rule of deducting from their sum the half-sum of the first and last. Then add to this sum algebraically 1-10 of (sum of first and last minus sum of penultimates).

Mr. Kent suggests the following general rule for determining any area given by equidistant ordinates as the best form of expressing Professor Durand's new formula in pocketbooks or notebooks, which seems excellent:

Add to the sum of all the other ordinates 4-10 of the first and last and 1 1-10 of the penultimates. Multiply the sum thus gained by the common distance between ordinates to obtain the area, or divide this sum by the number of ordinates to obtain the mean ordinate.

Substituting the word "volume" for "area" and the word "section" for "ordinate," and this rule is applicable to the determination of volumes from equidistant sections as well as of areas from equidistant ordinates.

Our error would, we trust, have been corrected in the proof except that the proof was sent to Professor Durand himself before publication and hence was less critically read as to substance. We trusted to him in part; he trusted to us, and between two stools we fell to the ground.—Ed.)

ENGINEERING NEWS THESIS COMPETITION.

CORRECTION OF AWARD.

We regret to be compelled to withdraw one of the awards (the second Honorable Mention) announced in our issue of Dec. 7, that, namely, to the thesis entitled "Testing Iron and Steel by Impact," written by Mr. Paul Bright, graduate in 1893 of the Western University of Pennsylvania. The withdrawal is wholly without reflection upon the author, since we have ascertained that the cause which makes it necessary originated not only without his procurement, but without his knowledge, as below explained.

The cause for withdrawal of the award is the omission from the copy of the thesis sent in to us in competition of the following introductory paragraph, which formed a part of the original thesis now on file at the university:

> Through the kindness of Mr. E. D. Estrada I have been able to write my thesis on this very interesting subject. He kindly allowed me to assist him in investigating this subject, he supplying the machine, test pieces, etc. With him I have discussed this subject, and so from him I have obtained many new ideas about the testing of iron, etc. To him I am ever grateful for his great kindness. Paul Bright.
> June 10, 1893.

The copy of the thesis as furnished to us omits this introductory explanation, beginning abruptly with the words, "First, the frame," and the proceeding with a description of the testing machine and method of tests. This omission was made by direction of Prof. Daniel Carhart, under whose direction a copy of the thesis was made and sent in during an absence of the author from the city; and he explains that he ordered the paragraph omitted only with the idea and intent of conforming to our instructions as to the concealment of the identity of the authors of theses, as the rules of the contest required, and because he considered the following sealed letter from himself as a sufficient equivalent for the information contained therein, and as the only feasible method of conveying this information to us under the rules governing the competition:

> The "Testing of Iron and Steel by Impact" was written by Paul Bright, of Pittsburg, Pa., who assisted Mr. Estrada, C. E., in making a series of tests on this interesting subject. His deductions are embodied in thesis "B," and presented as his graduating paper for the degree of C. E. at the Western University of Pennsylvania in June, 1893. We believe it a paper worthy to be placed with those competing for the prizes offered by Engineering News.
> Danl. Carhart, Dean and Prof. C. E.

Unfortunately, whatever the intent of this omission, which the judges do not question, its practical effect was that the judges were entirely misled as to the actual work which the writer of the thesis had done, and greatly overrated it. Until the awards had been made and privately announced they were not even aware that Mr. Estrada or any other person except the author had had any connection with the work whatever, either as designer of the machine or method of test; and even after the awards had been made and the text of Professor Carhart's accompanying sealed letter was before them, it did not occur to the judges, in view of the closing certificate, that the tests in which the author had assisted Mr. Estrada were the same as those submitted in the thesis as (by necessary implication) his own work. They had observed, however, that the thesis was of notably unequal merit, as will be seen from the following extract from our article of Dec. 7, 1893, announcing the awards:

> The paper to which our second Honorable Mention was awarded, on testing iron and steel by impact, suffered also from this cause (that a little greater range of tests would have added materially to the value of the results). The admirable choice of subject (in a fruitful and too much neglected field), the excellent testing machine which was devised by the author, and his general method of making tests, gave promise of a paper which would deserve a high award; but the promise was not maintained in the amount of testing which was done after thus preparing for it, and, above all, elastic limit determinations were almost ignored, and there were other defects into which we cannot now enter. The literary form of the paper was also bad. These features of conspicuous defect almost overbalanced its features of conspicuous merit. We shall publish a full abstract of this paper as outlining a hopeful method for further investigation, and giving some actual results of real value.

The features on which the award was chiefly based are precisely those for which, as now appears, Mr. E. D. Estrada, and not the author, was entitled to credit; which is not surprising, as Mr. Estrada is a practicing engineer of experience, who has for some years had his attention attracted to the subject as a result of some observations made when connected with the Cincinnati, Hamilton & Dayton R. R. As a result of this interest and study he had made certain quite extended tests which were in part only made in conjunction with Mr. Bright and appear in his thesis, but all of which are included in a paper by Mr. Estrada before the Engineers' Society of Western Pennsylvania, published since the thesis was sent in to us, but before the awards were made. To the accident that this paper had been laid aside for abstract in these columns without careful perusal was due the fact that the evident coincidences between the paper and thesis did not attract attention before the awards were announced. As a matter of fact we were indebted to Mr. Max. J. Becker for calling our attention to them, though we should doubtless have discovered them later in any case. The delay which has occurred since this notification in correcting the award has been required in order to make proper investigations, to insure that no injustice might be done to any one concerned. Considerable delay and correspondence were required in order to ascertain, first, that there was any preface to the thesis which was omitted; second, its exact wording; thirdly, that the author was not responsible for the omission, and fourthly, that his younger brother, who acted as messenger and agent in procuring a copy, was not responsible.

WATER WASTE PREVENTION OR INCREASED PUMPING CAPACITY.

(Concluded from p. 57.)

The question confronting the city of Evanston, Ill., when Mr. Henry S. Maddock began the investigations, a part of the results of which were given in our last issue, was whether more pumps should be bought for the city water-works, or some means should be adopted for curtailing the waste of water. To determine the water consumption in

other cities, and ascertain what they were doing and what they thought should be done to prevent waste Mr. Maddock sent out a large number of circulars, from which the table in our last issue was prepared. The replies to these circulars showed that an excessive amount of water was being pumped in Evanston in proportion to its population, and that the officials in other cities to which inquiries were sent generally favored a reduction of consumption and waste by means of inspection and meters.

In order to understand the exact situation in his own city Mr. Maddock prepared two diagrams, reproduced here as Figs. 1 and 2. The first of these diagrams shows the daily pumpage, mean temperature, precipitation and the pounds of coal consumed per 1,000,000 gallons pumped for the year ending Nov. 30, 1893. The second diagram shows the same facts for the months of August and November, 1893, but the consumption is represented by four-hour periods.

Mr. Maddock has sent us the following comments on these diagrams:

The water pumped during the months of April and November (Fig. 1) represents the waste through leaky fixtures and the legitimate use for domestic and manufacturing purposes. The leakage from our water mains is small, as in our soil leaks show on the surface in a very short time.

The water pumped from Dec. 1 to April 1 represents waste through leaky fixtures, legitimate use for domestic and manufacturing purposes, and also the water allowed to go to waste to prevent fixtures from freezing. The amount of water used for this last named purpose depends on the temperature, as the diagram plainly shows.

The water pumped from May 1 to Nov. 1 represents the waste through leaky fixtures, legitimate use for domestic and manufacturing purposes, and the water used for lawn sprinkling. We have wide streets and parkways and liberal lawns. The amount used for lawn sprinkling is of course affected by both the precipitation and temperature.

The object of the diagram giving consumption by periods of the day during August and November, Fig. 2, was to ascertain the waste of water. The night pumpage from midnight to 4 a. m. in November shows waste through leaky fixtures, which was about 350,000 gallons for the four hours. The increase during the day was small. Of course the consumption of water was greater than the increase over the night pumping, as what was running to waste during the night was partly used during the day.

The pumpage from midnight to 4 a. m. in August represents the waste through leaky fixtures and also through lawn sprinklers allowed to run continuously during the night. This averaged for the month 514,000 gallons, being about 160,000 gallons per day over the waste for the month of November, and showing a fluctuation of from 410,000 gallons on Aug. 29 to 620,000 gallons on Aug. 4 and 10, caused by the lawn sprinklers running at night.

Another object of this diagram (Fig. 2) was to ascertain how closely at different periods of the day the consumption approached the full capacity of the pumping plant. Aug. 19, from 4 to 8 a. m., was the period of maximum pumping (about 1,200,000 gallons, or at the rate of 7,200,000 gallons per day) and this was very close to the capacity of the pumping plant.

Coming now to coal, we use Indiana block, of the best quality we can procure. The diagram for the year (Fig. 1) shows a wide range in the amount required to pump 1,000,000 gallons. In some cases the increase is controlled by the fall in the temperature, and where the increase is not apparently controlled by this means I believe an investigation in the direction of the force and direction from which the wind blows would throw some light on the consumption of coal. I think the increased amount of fuel used in winter comes more from heating the building than the difference in temperature of water fed to the boiler, as we use as far as possible the condensed steam.

The roof over the boiler house is of corrugated iron and there has not been anything done to prevent the warm air coming in direct contact with the iron. Over the engine house the roof is one inch boards with shingles nailed on. I am of the opinion that a false ceiling in both boiler and engine house would save coal. The walls are of solid brick, and no method has been adopted to prevent the warm air from coming in direct contact with them.

I believe that in this climate it would be economy to put a coat of non-conducting material on the inside of the walls, as our coal consumption is about one-third greater in winter than in summer.

Early in November, 1893, Mr. Maddock made a very careful report on the subject of enlarging the works or curtailing the waste of water. It seems that the purchase of a 12,000,000-gallon pumping engine was under consideration at the time, which Mr. Maddock states would necessitate an immediate outlay, as follows:

Pumping engine	$50,000
Addition to building	5,800
Larger mains	24,500
	$79,300

The daily water consumption per capita at that time was 144 gallons, which Mr. Maddock stated was double what it should be. If the interest at 5% on the $55,000 needed to install the pump should be invested in meters Mr. Maddock urged that the expense of operating the present plant would be decreased and the revenue increased. He recommended vigorous measures to prevent the waste of water and proceeded to discuss the waste and its prevention. This discussion is abstracted below and some parts of it may be more clear if reference is made to the diagrams already described above.

In August, 1888, on a basis of population of 7,020, as shown by a school census, the average daily consumption was 175 gallons per capita. In August, 1893, with a population estimated from the local directory as 18,000, the consumption was 258 gallons per capita, an increase of 47% in five years.

Reference was made above, in the matter sent us by Mr. Maddock, to the difference between the August and November night consumption in 1893. Table I. shows the difference for the six four-hour periods of the day, the figures being averages for the whole of August, but for only the first two days in November, the decrease, according to Mr. Maddock, representing water used on lawns in August.

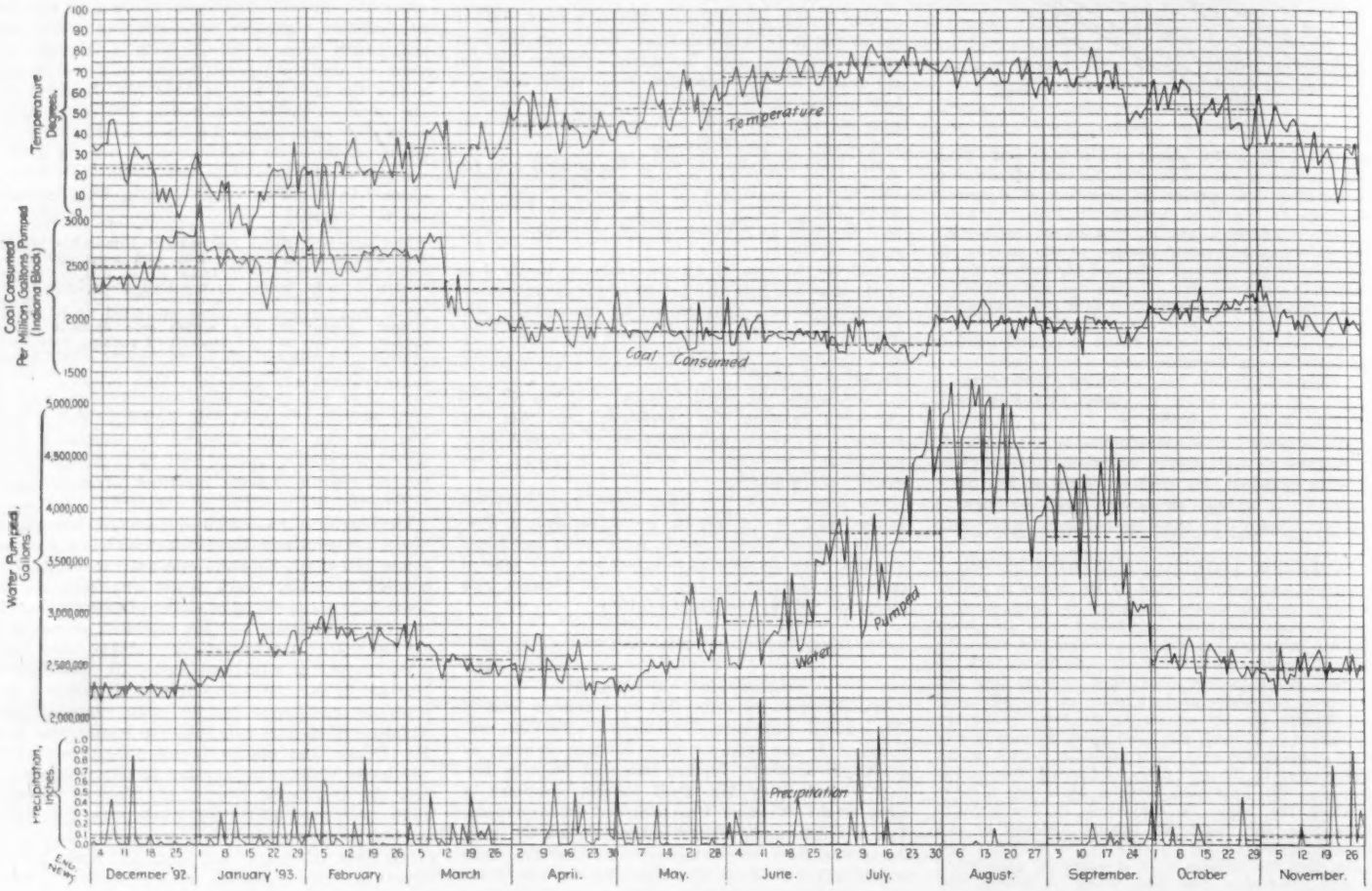


FIG. 1. DIAGRAM SHOWING DAILY WATER PUMPAGE, PRECIPITATION, TEMPERATURE AND COAL CONSUMED PER MILLION GALLONS PUMPED AT EVANSTON, ILL., DECEMBER, 1892, TO NOVEMBER, 1893, INCLUSIVE. Henry S. Maddock, Commissioner of Public Works.

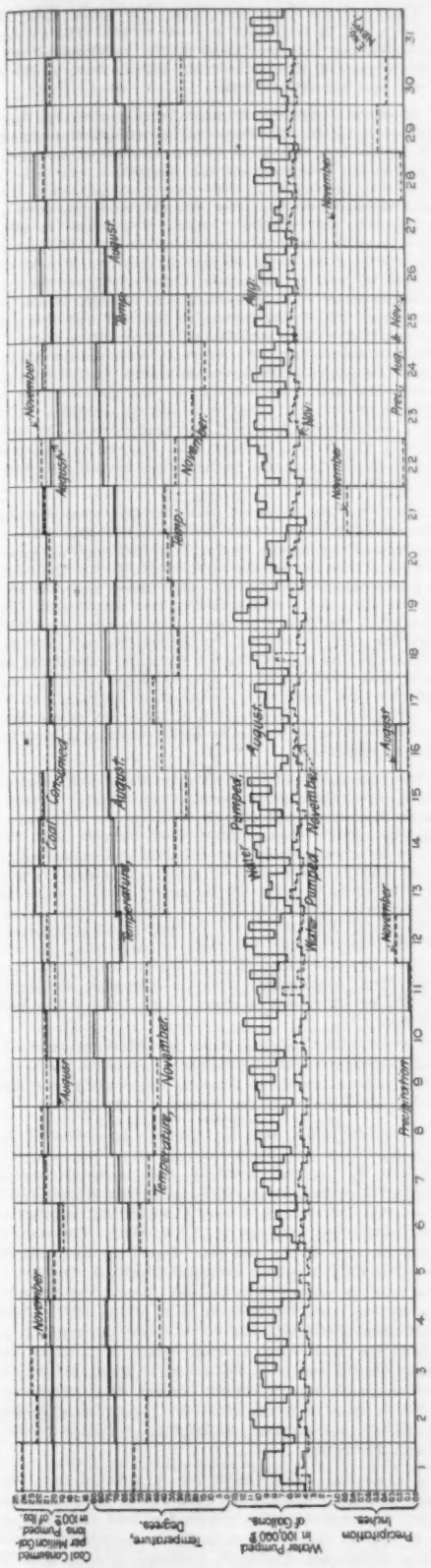

Coal Consumed per Million Gallons Pumped into 100° of Ins.
Temperature, Degrees.
Water Pumped in 100,000's of Gallons.
Precipitation Inches.

Fig. 2. Water Pumpage at Evanston, Ill., by Four-Hour Periods, August and November, 1893.

TABLE I.—Average Consumption of Water at Different Periods of the Day for the Month of August and for the First Two Days of November, 1893.

	August. Gallons.	November. Gallons.	Decrease. Gallons.
Midnight to 4 a. m.	526,400	354,504	171,896
4 a. m. to 8 a. m.	839,797	367,230	472,567
8 a. m. to noon	952,295	499,742	452,553
Noon to 4 p. m.	742,732	438,030	304,703
4 p. m. to 8 a. m	950,518	414,349	536,169
8 p. m to midnight.	630,669	360,488	270,181

To show the inequality of the present mode of water charges by assessment, Mr. Maddock presents another table, given here as Table II. This table is based on meter readings for October and November, 1893, multiplied by three to obtain the consumption for six months. The last column gives the schedule rates these consumers were charged for the six months May to Nov. 1, 1893, and the next to the last column is the cents per 1,000 gallons used which the consumer actually paid.

TABLE II.—Half-Yearly Water Consumption of 19 Consumers, Based on Two Months' Meter Readings, and Total Rates and Rates per 1,000 Gallons Actually Paid to the City.

Consumer.	Gallons used, May 1. to Nov. 1.	Actual rates, in cts., paid city. Per 1,000 galls.	Total, $
No. 1	36,432	.19	7.60
No. 2	17,490	.23	4.00
No. 3	15,824	.32	5.10
No. 4	342,608	.03	10.60
No. 5	212,888	.07	14.80
No. 6	279,178	.04	12.30
No. 7	132,409	.16	22.50
No. 8	222,272	.06	13.00
No. 9	189,704	.06	12.60
No. 10	2,303,496	.02	50.00
No. 11	83,168	.14	11.60
No. 12	1,214,032	.05	63.20
No. 13	325,784	.09	36.70
No. 14	156,768	.12	19.80
No. 15	135,792	.03	2.40
No. 16	92,448	.49	11.00
No. 17	223,192	.05	11.05
No. 18	167,272	.36	38.60
No. 19	36,432	.14	5.20

For the water pumped during the fiscal year 1892-3 the city received only 3.53 cts. per 1,000 gallons, while the cost of furnishing the water was 4.44 cts. Whether account is taken of the water used for fire protection and other public purposes is not stated, but without regard to this point Table II. shows gross inequality in the assessment rates for these 19 consumers, as they were paying from 2 to 49 cts. per 1,000 gallons for the water they used.

Regarding the assertion that as Evanston has an unlimited supply of water to draw upon the users should have it free, or without restriction upon its use, Mr. Maddock answers:

> Where men congregate together in large numbers nothing is free, not even the air which we breathe. We have to spend money for inventive genius to procure methods of ventilation and also for constructing the apparatus or method when discovered. The trapper in the forest has to spend time and energy to bring the water from the brook to his hut. An abundant supply of water should be provided for all legitimate purposes, but waste of water or anything else should not be encouraged under any consideration.

That every cent, and more, collected as water rates is needed to carry on the works is shown by the following lucid statement:

> For the present fiscal year the cost of water will be approximately as follows:
>
Operating pumping station	$8,620
Looking after mains, valves and hydrants	3,120
Collecting water rents	1,000
Five per cent. interest on $399,100 invested in pumping station and mains	19,955
Five per cent. interest on $224,100, invested in the pumping station, to make renewals and repairs	6,205
Two per cent. interest on $275,000, invested in mains, valves and hydrants to make renewals and repairs	5,500
Approximate total cost of operating the works.	$44,400
>
> There will be pumped about 1,000,000,000 gallons, which at 4 2-5 cts. per thousand would yield a revenue of $44,000. The revenue this year will be less than $40,000. The $19,955 should be used first to pay the interest on water bonds and the balance, if any, set aside as a fund for extensions. The $6,205 should be used to make the necessary repairs and renewals at the pumping station and if any money is left over from one year, put in a fund to meet the extensive repairs which are sure to come in the future. The $5,500 from the water mains should be used to meet the expense of renewals and repairs and should any money be left over at any time it should be put in a fund to meet the extensive renewals which are sure to come in the future.

To the common remark: "I have paid my water tax and I am going to use all I please—there is plenty in the lake," Mr. Maddock answers that the consumer has really paid for only a reasonable amount of water through certain fixtures. But if a meter is put on an extravagant water user, his lawn sprinkler is not allowed to run all night, nor will the officials need to tell him twice that he has leaky fixtures.

Meters being unquestionably desirable, Mr. Maddock estimates that 300 ¾-in. meters at a cost of $7,500, including setting, would check the waste of water. The cost of meter repairs per year in the four following cities in 1892 is given as follows, the last column being ours:

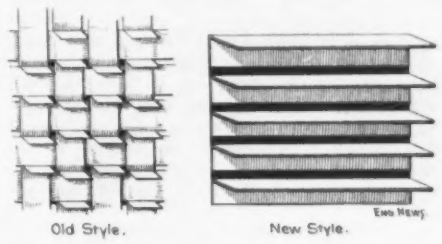
	No. meters.	Cost of repairs. Total.	Cost of repairs. Av. per meter in use, cts.
Waltham, Mass.	59	$7.70	.13
Springfield, Mass.	1,402	215.29	.15
Detroit, Mich.	2,061	259.28	.12
Binghamton, N. Y.	395	142.20	.36

These prices range from 12 cts. per meter for Detroit to 36 cts. for Binghamton. The sizes of meters in the above cities are not stated, but the cost per million gallons of water for maintaining various sized meters in Boston in 1890 is given as 25 cts. for ½-in., 22 cts. for ¾ and 40 cts. for 1-in. meters.

This study by Commissioner Maddock, as given above and in ous issue of Jan. 18, is a highly creditable one and will doubtless be of great value to Evanston, as it certainly will be a help and encouragement to those who are fighting water waste elsewhere.

ICE TANKS OF WICKES REFRIGERATOR CARS.

The accompanying cut represents the old and new styles of construction for the walls of the ice tanks in the Wickes refrigerator cars, and should have accompanied the letter referring to these cars on p. 52 of our issue of Jan. 18. The old style consists of interlacing ribbons of galvanized iron with U-shaped metal strips inserted at each crossing to increase the cooling surface. This allows the air to pass from every part of the ice receptacle into the air passage or ducts which surround the tank on four sides. The metal basketwork and U-shaped insertions must be woven by hand, and the quantity of iron used is very great as compared



Walls of Ice Tanks for Wickes Refrigerator Cars.

with the surface covered, while the numerous layers of metal form pockets for dirt and straw, resulting in corrosion and foul air. The new style has angle irons 3×4 ins., the full width of the car, giving a continuous metal shelf 3 ins. wide, projecting into the air passage. These plates are placed 1 in. apart, so that the air passes from the tank in sheets, instead of through perforations. This style is claimed to be cheaper, less liable to collect dirt and more easily cleaned, while being equal to the old style as a refrigerating device.

WATER SUPPLY AND WATER POWER AT AUSTIN, TEX.

We have given our readers full information from time to time* of the progress of the enterprise which the city of Austin, Tex., has undertaken, consisting of the building of a great masonry dam across the Colorado River, by which a water power amounting to some 9,000 HP. per day of 10 hours is obtained. This power is to be utilized to pump water for the city's water supply, furnish electric current for both public and private lighting, operate an electric street railway, and furnish power to users of electric motors. The remaining power will be rented to manufacturers. The annual report of the Secretary of the Board of Public Works, Mr. W. J. Oliphant, gives an account of progress to date. As will be remembered, a break occurred on May 30, the river finding its way through a cave or fault in the rock underlying the headgate masonry, at a depth of about 25 ft. below the foundations. The break was cut off by a cofferdam and repairs were begun, first under direction of Mr. E. W. Groves and later under the late Gorham P. Low. The total cost of repairing the break has amounted to $30,531, and the contract for replacing the headgate masonry will make an additional expense of $16,000. The work on this contract is now well advanced. Contracts were let during the year for building the power house, for light and power dynamos, and for cast iron pipe and specials. The contracts for hydrants and for castings, racks, penstocks, turbines, shafting pulleys and other power house machinery were

* See Eng. News, April 1 and 8, 1876, for account of this failure, and "Trans. Am. Soc. C. E.," Vol. V., pp. 244-50, for report on same. Mr. Taylor's paper will be published in the Journal of the New England Water-Works Association.

let in the previous year. The legality of the bonds issued by the city to carry on the works has been contested in the courts by the bondholders of the old water company; but in a decision handed down May 25, 1893, the Texas Supreme Court sustained the legality of the new bonds. The city still holds $438,000 of these bonds, which must be marketed in order to raise funds to complete the works. Mayor McDonald states in his message that those interested in the old water company are still using their influence to prevent the sale of these bonds, and recommends that the city institute legal proceedings against those who have circulated reports affecting its credit.

The mayor proposes that a uniform meter rate of 12½ cts. per 1,000 gallons be charged, and estimates that on this basis the city will have an annual revenue of $68,500 from its water supply system; for electric lighting he proposes a rate of 25 cts. per month for each incandescent lamp, and estimates that at this rate fully 15,000 lamps would be used, making a gross revenue of $45,000 per annum. For power, heating, cooking, etc., he estimates that 1,000 HP. can be disposed of within a year from the time it is made available, which, at $40 per HP. per annum, would give $40,000 additional to the city. This would make a total revenue of $153,500 per annum, with the resources from the sale of additional water power still available. The total amount expended on the dam, water-works, electric plant, etc., to Nov. 30, 1893, was $970,642. It is claimed that the proceeds from the sale of the $438,000 in bonds still unsold will be sufficient to complete the works. If the total cost of the works amounts to $1,500,000, the interest charge at 5% will be but $75,000 per annum.

THE EAST PROVIDENCE STAND-PIPE FAILURE.

The following account of the failure on Jan. 19 of the stand-pipe connected with the new water-works of East Providence, R. I., was prepared for us by Mr. Geo. H. Leland, Assistant Engineer to Mr. S. M. Gray, M. Am. Soc. C. E., who was chief engineer for the works. An account of the accident to the pipe which occurred last September, and is mentioned below, was given, together with a sketch of the bent structure, in our issue of Sept. 21, 1893. Mr. Leland writes as follows:

Referring to the accident which occurred to the East Providence stand-pipe Jan. 19, I would say that the stand-pipe was 40 ft. in diameter and 125 ft. high, surmounted with a conical roof about 40 ft. in height, with four dormer windows for ventilators.

The specifications called for first-class American rolled steel with a tensile strength of 60,000 lbs. per sq. in. Test pieces were cut from the sheets and subjected to tests, the records of which show an average of 62,000 lbs. per sq. in. and an average elastic limit of 37,000 lbs. per sq. in. The bottom of the pipe was formed of ¾-in. steel plates cut into radial strips. The first or bottom course was 1 9-32 ins. in thickness and was secured to the bottom plate by a 6-in. angle iron riveted with two rows of rivets each, in the plates and bottom. Each course was made to build 5 ft. in height and of the following thickness:

No. of course.	Thickness, ins.	No. of course.	Thickness, ins.
1	1 5/32	9	¾
2	1 1/16	10	11/16
3	1 1/32	11	5/8
4	1	12	9/16
5	1	13 and 14	½
6	13/16	15 and 16	7/16
7	7/8	17 to 20 inclusive	3/8
8	13/16	21 to 25 inclusive	5/16

The first five horizontal and vertical seams were triple-riveted with 1⅛-in. rivets and with laps of 8 ins. The next ten horizontal seams were double-riveted and the last five horizontal seams were single-riveted. All vertical seams above the first five courses were double-riveted.

The contract for the stand-pipe above the foundation was let to the Cunningham Iron Works, of South Boston, Mass. It was erected under the superintendence of Mr. G. H. Griffin, of Cleveland, O. A staging on the inside was used in its construction. The contract for building the roof and balcony was sublet to the Belmont Iron Works, of Philadelphia, and by them sublet again to Tippett & Wood, of Phillipsburg, N. J. The above is a brief statement of its construction.

On Aug. 29, 1893, a severe windstorm struck the stand-pipe, which was then completed to 120 ft. with the exception of two plates in the last or 24th course. During this storm the top swayed in and out like a large tree. The bottom on the windward side would lift from the foundation ½ to ¾ in. It was estimated that the wind at this time was blowing 60 miles per hour, but no harm was done to the stand-pipe at that time.

Early in September, when the pipe was 120 ft. high, a cyclone of ten minutes' duration struck it and forced the top in for a distance of about one-third of its circumference and extending down 36 ft., like the letter "V" (see Eng. News, Sept. 21). Fear was then entertained that as the center of gravity had been shifted it might overturn. Water was immediately turned into the pipe without removing the staging, forges and other tools used in the construction, which were within the stand-pipe. When the water reached a level of about 100 ft. the top was forced out to its original shape, excepting a few wrinkles at the bottom of the "V."

The contractor labored upon the damaged plates until the wrinkles were hardly perceptible when filled with water, but when the water was drawn down to this point, or 85 ft. from the bottom, the depression in the pipe was plainly visible. It was on this account that the district had not accepted the pipe. The contractor had been making efforts to repair this defect when the cold weather set in and he was obliged to stop work.

The floating staging which had been used in the erection of the roof, consisting of several barrels and timber, was left in the pipe with the water at 95 ft. All communications with the water mains were closed until Jan. 14, about one week previous to the accident. On that day the contractor sent his foreman into the pipe with instructions to cut the ice free from the pipe and then to have the valve opened to allow communication with the mains, which was accordingly done and so remained until the accident, which occurred on Friday evening, Jan. 19, at 7:50 o'clock, with a loud report.

From general appearances it seems the pipe first burst at a point 55 ft. above the bottom on the southwest side. The first ten bottom courses on the same side were rent asunder and were unrolled and carried a distance of 150 ft. to the northeast with the lowest course farthest away from the foundation and outside uppermost. One large section of the bottom course was hurled over a pile of earth, some 10 or 12 ft. high, without even scratching the earth.

The upper 75 ft. appear to have dropped perpendicularly just south of the foundation and then toppled over to the south. The roof lies all within the pipe, with the peak lying diagonally down, excepting one dormer window, which was hurled to one side. A barn which stood within 20 ft. of the pipe was completely swept away, as well as 300 ft., more or less, of stone wall, several hundred feet away. The foundation of the pipe, which was laid up in Portland cement, remains intact. The bottom of the stand-pipe remains on the foundation, but with the edges torn and twisted. Large blocks of ice lie strewn around in various directions varying in thickness from 3 to 18 ins. The heavy steel plates that composed the lower courses are bent, twisted and torn into innumerable shapes and sizes, but the triple-riveted joints remain firm and solid; in one or two cases, however, the double-riveted joints pulled apart instead of tearing the plates.

There was said to have been less than 100 ft. of water in the pipe at the time of the accident. The fractures and flexures of the steel plates show an excellent quality of material. Further investigations will doubtless be made to ascertain if possible the cause of the accident.

One of the attractions of the Midwinter Fair of California is to be a tower 270 ft. high, with Otis elevators running at a speed of 200 ft. per minute and operated by electric power. The tower will be covered with 1,500 revolving electric lights of varied colors and surmounted by a search light with a 6-ft. lens.

The price of steel rails, says "The Iron Age," for 1893, was steadily held by the combination of makers at $30 per ton until November. The price then fell to $28, and in December was cut to $25. The average price for the year was about $29.50, as compared with an average of $31.17 for 1892; $31 in 1891; $34.50 in 1890, and $31.37½ in 1889.

An electric conduit street railway system has been invented by Mr. H. Peterson, an electrical engineer, of Milwaukee, Wis. He uses a conduit of cast iron, with about two-thirds of the conduit to one side of the slot and divided into two compartments. The one compartment is under the slot and the other is practically air and water tight. The latter contains two insulated rails in circuit and carrying the power, and is kept dry by a continuous current of cold air forced by fans at the power house. Between the two compartments is a connecting slot through which an arm from the trolley passes to the car, and this slot is provided with a self-closing device which opens as the car approaches and closes as soon as the trolley arm has passed. The inventor claims that cable systems can easily be altered to his, and that by a simple device the same car can be operated on a part underground and part overhead system. As near as can be learned, however, the system, as yet, only exists in the form of a model, never having been tried in actual practice.

The six plans selected from the 134 presented for the new City Hall of New York will probably have to be rejected, as costing too much to build upon. The estimate of the commission was $8,000,000 for the building complete, while the structure based upon the best of the six plans would probably cost $20,000,000. The Municipal Building Commission insists that a suitable building can be erected for $8,000,000, and also declares that no one of the six plans is satisfactory inside and outside. It is also doubted whether any suitable and sufficiently inexpensive building can be evolved from a compounding of these six plans, even were the consent of the several architects gained for this combination.

The concessions of the Nicaragua Canal Co., obtained from the Nicaraguan Government, expire if active work is discontinued on the canal for six consecutive months. Work was stopped four months ago, and there is a rumor that to save this concession operations will be resumed next month. President Zelaya, of Nicaragua, has, through Minister Guzman, asked our government what action it is going to take in the matter, and says that while he prefers the continuance of the canal under American management, he will cancel the concession at the expiration of the time and open negotiations with a European syndicate, which, he hints, stands ready to apply for a new concession.

The Canadian canal at Sault Ste. Marie is approaching completion and the builders expect to open the canal next summer, as Toronto reports say that the lock is now ready for the hanging of the gates.

Cable car traffic pays in Chicago. According to the last reports of the North Chicago Street Ry. Co., Mr. Charles T. Yerkes, President, that company carried 60,311,673 passengers in 1893 and earned $3,101,148.45. The total disbursements were $1,946,630.43, leaving the comfortable net earnings of $1,154,509.82. The average daily receipts during the year footed up to $8,259.70, and the daily expenses averaged $3,870.56. On Oct. 9 the receipts amounted to $16,343. Poor gives the mileage of this road, for 1893, at 83.38 miles; capital stock paid in, at $5,000,000, and bonded debt outstanding, at $2,350,000. The West Chicago Cable Ry., under the same control and with 190 miles of track, $11,000,000 paid-in stock and $4,100,000 bonded debt, reports as follows: Gross earnings, $5,235,633; operating expenses, $2,892,982; net earnings, $2,342,651; applicable to dividends, $1,400,901.

A somewhat large expert fee is involved in a suit now said to be pending between Prof. Henry A. Rowland, of Johns Hopkins University, and the Cataract Construction Co., of Niagara Falls. According to the press dispatches, Professor Rowland was retained to review and report upon all the plans submitted for utilizing the water power at Niagara Falls. He sent in a bill and was paid $10,500 for this service. He is now said to be suing for $30,000 more, declaring that his former bill was too small. Fuller detail of the controversy might probably modify this general statement.

The New York jury which has been hearing testimony in the case of Professor Rowland, of Johns Hopkins University, against the Cataract Construction Co., has rendered a verdict in favor of Professor Rowland for $9,000. Professor Rowland had been engaged for over six months in designing and considering plans for the construction of a 5,000 HP. dynamo to be used in transmitting electrical power from Niagara Falls to Buffalo. He sent in a bill for $10,000 for these expert services, and the company paid him $3,500 and refused to pay more on the ground that a $10,000 fee

was exorbitant. Professor Rowland thereupon made out a new bill at $150 per day for the whole time, amounting to about $30,000. The verdict of the jury gives him $5,500, in addition to the $3,500 paid on $9,000 in all.

There is now an apparent bona fide bid for an underground rapid transit road in New York, as well as one for an elevated system on the route of Commissioner Busshe. This bid comes from Mr. R. T. Wilson, who is backed by ample capital, and offers $1,000,000 cash security. Mr. Wilson proposes an underground road on the route laid down by the commission, but would build two double-track, independent tunnels, one over the other instead of side by side, as originally proposed. He also asks that the city of New York loans its credit for two-thirds of the estimated cost of $45,000,000. This $30,000,000 is to be paid, principal and interest, by the company. The full details of the proposed scheme are now under consideration, and at present it can only be said that they are being carefully studied by the commission, with favor, so far.

An excellent pile-driving record is sent us by Mr. L. C. Fritch, Engineer of Maintenance of Way on the Ohio & Mississippi R. R. In three hours seven bents of piles, four piles per bent, were driven to an average depth of 15 ft. Including all labor in handling, etc., the actual cost of driving was 2 cts. per foot of pile, and the cost per pile driven averaged 30 cts. Of the 28 piles, 8 were 25 ft. long, 8 were 16 ft. and 12 were 22 ft. long. Our correspondent does not specify the material penetrated, though the speed noted would imply easy driving material.

One of the largest screw-testing machines yet built is being erected at the College of Civil Engineering of Cornell University. It is designed for direct tension and compression and transverse strains. Its extreme dimensions are: Height, 20 ft.; width, 5 ft., and length, 15½ ft. Its weight is about 33,000 lbs. It will admit bars for tension and columns for compression of any length up to 12 ft. The capacity of the machine is 400,000 lbs. for tension and compression, and 100,000 lbs. for transverse strain. The machine was made by Riehle, of Philadelphia, and the beam is provided with the Riehle traveling vernier poise, adjusted to standard weight and moving automatically.

An ingenious system of lighting and extinguishing street gas lamps has been developed by the Cutter & Hammer Mfg. Co., of 247 South Jefferson St., Chicago. Electricity is the agent employed for lighting, and is furnished by a small battery placed in the base of the lamppost. To light the lamps a valve is opened at the works connecting one of the large holders with the mains and considerably increasing the pressure in the latter. This increased pressure raises a miniature gas holder in the lamppost, immersed in a mercury bath, and it comes in contact with a stop which closes the battery circuit. The electric current causes an armature to vibrate and turns a ratchet wheel, which turns on the gas, and lights it by throwing off sparks. The increased pressure is maintainedh for about 15 seconds, and normal pressure is then restored. To extinguish the lights the pressure is increased as before, and the ratchet wheel is now so turned as to shut off the gas.

CONSTRUCTION NEWS.

RAILWAYS.

East of Chicago—Existing Roads.

EBENSBURG & BLACK LICK.—It is reported that Chas. McFadden, the contractor, has about 700 men at work on this railway, which will extend from Ebensburg, Pa., to Black Lick Station, on the Pennsylvania, 10 miles. About half of the grading has been completed.

INTERCOLONIAL.—It is reported that the government has decided to proceed with the construction of the branch railway from Halifax, N. S., to Dartmouth.

PATH VALLEY.—The grading on this road is reported as progressing rapidly and work has been commenced on the tunnel proper south of New Germantown, Pa.

PENNSYLVANIA CO.—Plans are being considered by this company and the city council of Allegheny, Pa., for the elevation of the company's tracks in that city.

Projects and Surveys.

COLLINGWOOD & TORONTO.—Residents of Collingwood, Ont., are trying to secure the construction of this proposed railway to Toronto, 70 miles; estimated cost, $2,600,000; Ch. Engr., Frank Moberly.

CLEVELAND & SOUTHWESTERN.—The work of grading this road, referred to last week, is reported to have been commenced where large fills are necessary.

PLYMOUTH COUNTY.—This company has been reorganized and it is reported that the proposed road will be built this year. It would connect with the Old Colony near East Weymouth, Mass., and extend to Brant Rock, 25 miles. Pres., John F. Simmons, Boston; Vice-Pres., C. S. Cushing, Hingham; Treas., Geo. Whiting, Boston.

WASHINGTON & CHESAPEAKE BEACH.—A reorganization of this company was effected at Washington last week; Pres., T. H. Anderson, Cambridge, O.; Secy., Capt. A. H. Mattox, Cincinnati; Treas., John G. Slater, Washington. It is stated that the contract for building the road, 30 miles long, has been awarded to Coffin, Sullivan & Suffern, New York, and the construction commenced. It is expected that the railway pier at Chesapeake Beach will be completed by March 15 and the entire railway not later than July.

WELLSTON STREET & BELT.—The Jackson & Wellston Terminal Ry. Co. has been incorporated under the above name and granted a 25-year franchise by the city council of Jackson, O. The road will run from McArthur Junction to Jackson, O., and will be 40 miles in length, including branches. Both steam and electricity will be used, according to reports. Capital stock, $1,000,000; directors, Harvey Wells, J. C. Clutts, H. S. Willard, Wellston, O.; C. L. Currier, I. E. Adams, Chicago.

Southern—Existing Roads.

CALDWELL & NORTHERN.—Work has been resumed on this railway, on which nearly 15 miles was graded last summer, beyond Lenoir, N. C., to Wilson's Creek. Ch. Engr., J. F. Montgomery, Lenoir, N. C.

COLUMBIA, LUMBERTON & GULF.—Incorporated in Mississippi to build a railway from Columbia, Miss., by way of Lumberton, Miss., to the Gulf of Mexico. The incorporators include T. J. Steward, receiver of the Gulf & Ship Island, Gulfport, Miss.; T. R. Stockdale, Summit, Miss.; Gen. T. S. Ford, Columbia, Miss. It is stated that over five miles of grading has been done and some track laid. The line runs through about 90 miles of pine forests.

JACKSONVILLE, ST. AUGUSTINE & INDIAN RIVER.—John D. Maclennan, who is building this road, noted last week, is reported as stating that 2,000 men are at work on the line and it is hoped to have the gap of 40 miles closed up next month.

MIDDLE GEORGIA & ATLANTIC.—The line from Newborn to Covington, Ga., 25 miles, has been completed. Ch. Engr., Arthur Pew, Talbotton, Ga.

MOBILE & OHIO.—Press reports state that an extension will be built from a point in Bibb county, Ala., on the Montgomery, Tuscaloosa & St. Louis branch, now under construction, to Birmingham, Ala., about 50 miles. The extension would pass through Bessemer and Blocton. Gen. Man., J. C. Clarke, Mobile, Ala.

Projects and Surveys.

LUMBERTON & LUMBER BRIDGE.—Organized to build a railway from Lumberton, N. C., to Lumber Bridge, 25 miles.

Northwest—Existing Roads.

DULUTH & WINNIPEG.—H. J. Payne, Ch. Engr. Duluth, South Shore & Atlantic, has commenced the survey for the proposed extension from Deer River, Minn., to St. Vincent, near the international boundary line. The work will be through thick forests and is expected to take several months.

Projects and Surveys.

WYOMING & PIERRE.—This company was incorporated several months ago to build a railway to coal mines in South Dakota. It is now stated that Marvin Hughitt, Pres. Chicago & Northwestern, is the chief projector of the road and that the line will probably be built in the spring from the mines purchased by the company, about 40 miles from Deadwood, to a connection with the Chicago & Northwestern. The general offices are at Dubuque, Ia.

Southwest—Existing Roads.

INTERNATIONAL & GREAT NORTHERN.—Efforts are being made to secure an extension from Columbia to Brazoria, Tex. A bridge across the Brazos River would be required.

LEAVENWORTH TERMINAL RY. & BRIDGE CO.—The directors have voted in favor of a belt line around the city of Leavenworth, Kan., and steps will soon be taken to secure surveys for a desirable route.

MISSOURI, KANSAS & TEXAS.—Surveys for the proposed extension to San Antonio, Tex., are nearly completed.——Press reports state that arrangements are being made for building a line to Kansas City. A preliminary survey has been ordered from Greenridge, near Sedalia, Mo., to Holden, on the Paoli branch.

ST. LOUIS, CAPE GIRARDEAU & FORT SMITH.—A press report from Perryville, Mo., states that Louis Houck is there making final arrangements for building the proposed railway from that city to Farmington, for which the surveys have been made, as noted in these columns.

Projects and Surveys.

BENTONVILLE, PINEVILLE & NORTHWESTERN.—Incorporated in Missouri to build a standard gage railway 16 miles long in McDonald county, between Caverna and Lanigan; capital stock, $60,000; C. M. Robinson, J. W. Shields, A. C. Walters, M. R. De Groff, W. E. Smith and others.

BROWNSVILLE & CORPUS CHRISTI.—Press reports state that the counties through which this proposed railway is to pass have raised the required bonus and that it is expected that the construction will be commenced this month. The road is projected by Sidney G. Miller, New York, and is to extend from Brownsville to Corpus Christi, Tex.

GULF & INTERSTATE.—The provisional directors of the North and South railway scheme met at Topeka, Kan., Jan. 9, 10 and 11 and adopted articles of incorporation. A railway is proposed from the Gulf of Mexico, in Texas, through Indian Territory, Oklahoma, Kansas, Nebraska, South Dakota and North Dakota, to near the south line of Manitoba; also a similar line from the gulf across Texas, Arkansas, Mississippi, Iowa and Minnesota to Lake Superior. The capital stock is to consist of 180,000 shares of $100 each. The directors include Fred. J. Close, Troy, Kan.; Albert Griffin, Manhattan, Kan.; A. Wardwell, Topeka, Kan.; E. Stoddard, Omaha, Neb.; E. J. Rundell, Wayne, Neb.; E. E. Carpenter, Canton, S. Dak.; C. J. Jones, Perry, Okla.; M. Kimpton, Fort Worth, Tex.; L. D. Featherstone, Forest City, Ark.; H. M. Dake, Brookfield, Mo.; Halva Halvorson, St. Paul, Minn.; A. J. Westfall, Sargent's Bluffs, Ia.

LITTLE ROCK, HOT SPRINGS & TEXAS.—Uriah Lott, projector of this railway, is reported as stating that construction will be commenced as soon as the route has been definitely located and the entire line will probably be in operation by next June. The road will be about 60 miles long and will be laid with 60-lb. steel rails. Several iron bridges will be required.

MISSOURI, OKLAHOMA & TEXAS.—Incorporated in Oklahoma to build a railway, to be in operation this year, from the southwestern corner of Missouri westward through the Cherokee Nation and Cherokee Strip with a branch from the Cherokee Nation southwest into Texas; capital stock, $5,000,000; directors, A. W. Spencer, Wm. Spencer, Yukon, Okla.; J. W. Waney, Elreno, Okla.; Bernard Corrigan, Kansas City; E. C. Simmons, St. Louis.

ST. LOUIS, AVOYELLES & SOUTHWESTERN.—Steps are being taken at Marksville, La., to secure the construction of this proposed railway from Bunkie, La., on the Texas & Pacific, to a connection with the Houston Central in Catahoula. It is stated that this would shorten the route between New Orleans and St. Louis 45 miles. F. M. Welch, Alexandria, La., is interested.

SAN MARCOS VALLEY.—According to reports the citizens of San Marcos, Tex., are trying to secure the construction of this railway, which was surveyed by the Southern Pacific a few years ago from Luling, Tex., on the main line, up the San Marcos River.

WYANDOTTE & SOUTHEASTERN.—Incorporated in Arkansas to build a railway from Wyandotte, Ark., into the timber country of Hot Springs county; capital stock, $300,000; J. H. Hamlin, Portland, Me.; W. F. Hill and B. F. Copeland, Little Rock, Ark., and others.

Rocky Mt. and Pacific—Existing Roads.

FLORENCE & CRIPPLE CREEK.—About seven miles of this road has already been graded and some track laid. Pres. Johnson is reported as saying that 15 miles of the line will be ready for the track within three or four weeks. About 1,200 men are at work on the line.

SOUTHERN PACIFIC.—It is expected that the headings of the long tunnel on the Pacific coast extension in San Luis Obispo county will meet this week.

Projects and Surveys.

CARSON & SACRAMENTO RIVER.—Walter Chedle, Carson, Nev., in an open letter advocates the building of a railway from Carson to the Sacramento River through Carson, Fredericksburg and Diamond Valley, around the south end of Lake Tahoe, through Lake Valley, then over the hill to Strawberry, down the American River to Placerville and from there to the Sacramento River, putting the state into direct communication with the ocean and making Nevada a competitive point. He advocates, according to the San Francisco "Chronicle," the building of a road by the state by the issuance of 3% bonds for $3,000,000, redeemable in 50 years, with the Governor, Controller, Treasurer, Surveyor-General and Attorney-General as the board of directors. He advocates the formation of a new party, electing legislators on a platform which inflicts the death penalty on all who sell out to competing roads. He would make the Governor superintendent, with the power to appoint an assistant, and would fix the passenger rate at $5 for a round-trip ticket to San Francisco, half a cent a pound the freight rate and $10 for a carload.

LAKE CHELAN & COLUMBIA VALLEY.—Incorporated in Washington by Francis H. Cook and L. C. Cook, Spokane, Wash.; capital stock, $500,000.

Foreign.

IZUCAR.—Press reports from the city of Mexico state as follows: President Diaz has signed the concession for the completion of the extension of the Inter-Oceanic Ry. from the town of Matamoras, in the state of Puebla, to the port of Acapulco, on the west coast of Mexico. The new concession goes under the name of the Izucar Ry., and the concessionaire is Senor Javier Algara. The money for the completion of the road was recently secured in London, and it is expected that work on its completion will be pushed.

MEXICO.—A change has been made in the concession granted to Luis Niendorff, William Dick and A. L. Clark for the construction of a railway from the port of Chamola, on the west coast of Mexico, to the city of Guadalajara, and thence to the city of San Luis Potosi, making, with the San Luis Potosi connection, a transcontinental line across Mexico to the port of Tampico on the Gulf of Mexico. The revised concession allows for extensions of the line to be made to the towns of Tequila, Etzatlan, Magdalena, Tequesquite and other points along the Barranca of Mochtiltic.

TEHUANTEPEC.—Reports state that the contract with Chandos S. Stanhope for the completion of this railway calls for the construction of the remaining 59 kilometers, and putting the line in order ready for the trains, and for the building of an iron wharf at the port of Palina Cruz, the western terminus of the road, the price being $1,113,035.

STREET AND ELECTRIC RAILWAYS.

SPRINGFIELD, MASS.—The street railway company is reported as contracting for the machinery for a new power station to be built in the spring; capacity 1,600 to 1,800 HP.

BUFFALO, N. Y.—The Buffalo Ry. Co. is reported to have contracted to construct an electric railway in Hertel Ave., the work to be done in the spring.

LEWISTON, N. Y.—The Lewiston & Youngstown Electric Ry. Co. is negotiating for the right of way through this place. The road is expected to be in operation before July 1.

BEACH HAVEN, N. J.—The Philadelphia & Beach Haven R. R. Co. has been incorporated by W. J. Sewell, C. S. Ridway, W. Brown, Camden, N. J.; W. Bettle, Haddenfield, N. J.; and others; capital stock, $200,000.

BORDENTOWN, N. J.—It is reported that the Trenton Electric Light Co. has completed surveys for an electric railway between this place and Trenton.

BRISTOL, PA.—After a delay of nearly a year the council has granted franchises to the Bristol & Trenton and Newtown trolley companies, according to reports, the construction of the lines to be commenced within three months.

DELAWARE WATER GAP, PA.—A company has been organized and $85,000 already secured toward the construction of an electric railway. Pres., J. D. Brodhead; Vice-Pres., A. B. Bachelder; Gen. Man., S. D. Overfield.

HAZLETON, PA.—A local paper states that the con-

tract for the extension of the Lehigh Traction Co.'s line from Harleigh to Freeland will be awarded in a few days. The road will take a direct route from Harleigh to Ebervale and thence to Drifton. Connection will also be made with Jeddo.

LANCASTER, PA.—The Pennsylvania Traction Co. has filed a mortgage for $2,000,000, covering the electric railway lines of Lancaster City, Lancaster & Millersville, Lancaster & Columbia, Columbia & Ironville, Columbia & Donegal and Lancaster & Strasburg.

McKEESPORT, PA.—It is reported that the McKeesport & Reynoldton Passenger Ry. Co. and the Versailles Traction Co. will each lay about two miles of track if the council will grant the rights of way.

MORRISVILLE, PA.—The Morrisville & Trenton St. Ry. Co. has been incorporated to construct a street railway from Trenton to this place; capital stock, $18,000; Pres., Wm. G. Howell.

SLATINGTON, PA.—The Slatington St. Ry. Co. has been incorporated to construct a street railway to Berlinsville; capital stock, $30,000; Pres., R. W. Mostellet.

SPRING CITY, PA.—A franchise has been granted to the Phoenixville Electric St. Ry. Co.

BERKLEY, VA.—A bill has been introduced in the legislature to incorporate the South Norfolk St. R. R. Co., which proposes to construct a railway in this town and county; capital stock, $300,000; F. S. Taylor, H. N. Johnson, P. L. Poindexter, M. Miller and others.

RICHMOND, VA.—The Henrico Ry. Co. has applied for a charter to construct a railway 16 miles in length; capital stock, $500,000; G. C. Vincent, W. H. Brauer, A. Monteiro, L. H. Kemp and others.

WHEELING, W. VA.—It is stated that the Wheeling & Elm Grove line may soon be extended to Triadelphia, 1½ miles.

JACKSON, O.—The council has granted a franchise to the Wellston St. & Belt Ry. Co. Harvey Wells, J. C. Clutts and H. S. Willard, of Wellston, are interested.

BAY CITY, MICH.—Preparations are being made to extend the electric railway to Essexville.

RACINE, WIS.—The street railway company has increased its capital stock from $150,000 to $200,000 and will extend its line to Mt. Pleasant and Caledonia.

MERRIAM, KAN.—The Merriam Park, Rosedale & Kansas City Electric R. R. Co. has been incorporated; capital stock, $50,000.

ELEVATED RAILWAYS.

CINCINNATI, O.—The project for a belt railway across the city is reported as having been revived and it is said a company will soon be incorporated with a capital stock of $6,000,000 to build the road. The scheme includes the completion of the 7,900-ft. tunnel, which was commenced in 1852, at a cost of $700,000.

CHICAGO, ILL.—It is said that the construction of the Lake St. elevated road as originally planned will be completed next month and that active work will then be commenced on the North Side branch.——It is reported probable that the construction of the Englewood extension of the South Side Alley road will be commenced within 60 days.

KANSAS CITY, MO.—It is stated that the Central Tramway Co. is planning to extend the elevated railway from the tracks on Eighth St. south along Wyandotte St. to Tenth St., east on Tenth St. to Baltimore Ave., south on Baltimore Ave. to Thirteenth St. and east on Thirteenth St. across Main St. to Walnut St., where a transfer will be arranged with the Grand Ave. company. By this means the Grand Ave. company would have an outlet to the Union depot, the West bottoms and Kansas City, Kan., while the elevated company's patrons would be helped by being placed nearer the retail center of the city as well as being given the opportunity to reach any point in Kansas City, Mo., touched by the Grand Ave. company's lines. This transfer would allow a ride of about nine miles for 5 cts.

HIGHWAYS.

NEW JERSEY.—The freeholders of Hudson county have opened bids for paving the boulevard, the lowest bids aggregating $499,871; estimated cost, $597,580. The Hudson Co. Contracting Co. was the lowest bidder on the first three sections, and Henry & McGivney on the remaining five sections. Other bidders were Donovan Bros, J. J. Coogan, M. T. Connolly, Holmes & Cogan, J. J. Harrington, B. Feeney, H. Schneider and P. J. Condon.——The freeholders of Gloucester county have appointed J. J. Albertson engineer to prepare plans for paving 1¼ miles of road, 16 ft. wide, in Swedesboro.

OHIO.—The commissioners of Hamilton county have directed the county engineer to prepare plans for improving Paddock road from Avondale to Glendale, a distance of eight miles; estimated cost, $400,000.

BRIDGES AND TUNNELS.

LUZERNE, N. Y.—Steps are being taken to require this town and Corinth to build a bridge across the Hudson River at Corinth; estimated cost, $18,000.

MONTCLAIR, N. J.—Bids are asked until Feb. 5 for constructing an iron bridge, as stated in our advertising columns. Henry L. Yost, Tn. Clk.

FAIRMOUNT, W. VA.—It is reported that plans are being considered for a bridge about 200 ft. long at this place.

POINT PLEASANT, W. VA.—The West Virginia Bridge Co. has been incorporated by W. E. Heslop, David Pierce, W. N. Howard and others; capital stock, $50,000.

PENSACOLA, FLA.—There is talk of the commissioners of Escambia and Baldwin counties building a new bridge across the Perdido River, according to reports.

MOBILE, ALA.—T. W. Nicol, Engr., informs us that the contract for a steel drawbridge and approaches over Three-Mile Creek has been awarded to the Youngstown Bridge Co., at $4,545 on non-creosoted piles, or $5,157 on creosoted piles, the other bids being as follows, the third price, when given, being with steel approaches: Penn Bridge Co., $5,923, $6,105; S. S. Leonard, $5,200, $5,500; Brackett Bridge Co., $4,950, $5,650; George N. Crafts, $5,660, $6,420, $6,550; Detroit Bridge Co., $5,737, $6,367, $6,596; E. A. Wilson & Co., $5,100, $5,850, $6,250; King Bridge Co., $5,300; E. Thacher, $4,900, $5,512, $5,732; Columbus Bridge Co., $5,200; Southern Bridge Co., $4,685; Edge Moor Bridge Co., $3,984 ,for superstructure only; C. P. Hammond, $3,000, superstructure only; W. H. Converse, $4,916, $5,560.

MILFORD, O.—The county commissioners have awarded the contract for a bridge at this place to the Brackett Bridge Co., at $25,000.

BOONE, IA.—The Chicago & Northwestern is reported as to build a new bridge across the Des Moines River at Moingona, Ia., at a cost of $50,000.

LAWRENCE, KAN.—It is stated that an engineer of the Missouri Pacific R. R. has been in the city several days taking soundings for a new iron bridge across the Kansas River where the old Kansas City, Wyandotte & Northwestern bridge now stands, and that a three-span bridge will be built there this spring.

SOUTH SIOUX CITY, NEB.—The Iowa & Nebraska Pontoon Bridge Co. has been incorporated to operate the pontoon bridge now in use and possibly to construct a wagon bridge across the Missouri River; Gen. Man., R. A. Talbot; Secy., Jos. Geisler.

AUGUSTA, MONT.—The county commissioners have selected a site for a steel bridge across the north fork of the Sun River near this place, one-half of the expense to be borne by Teton county and one-half by Lewis and Clarke counties.

DAYTON, WASH.—The Star bridge across the Touchet River and several foot bridges were washed away by high water last week.

WATER-WORKS.

ATTLEBORO, MASS.—The town has voted to petition for authority to issue $50,000 of bonds to extend the works to Hebronville and Dodgeville.

BARRE, MASS.—A committee has been appointed to secure money for plans and estimates for works.

GREENFIELD, MASS.—The commissioners are reported as having voted to put meters in the manufacturing establishments before April 1.

IPSWICH, MASS.—The estimated cost of proposed works is $130,000. A previous estimate was $80,000, according to reports.

LYNN, MASS.—The superintendent has been authorized to ask for bids for a supply of pipe, probably about 8,000 ft. of 4 and 6-in. and 20,000 ft. of surface pipe.

PITTSBURG, MASS.—The committee has voted in favor of issuing bonds for $30,000 for the extensions noted last week.

QUINCY, MASS.—The mayor has recommended the immediate passage of the ordinance for $60,000 of water bonds.

SPENCER, MASS.—The committee has voted to recommend the construction of a stand-pipe. N. E. Craig, Engr.

UXBRIDGE, MASS.—The town has voted to petition for authority to take a supply from Mendon Pond.

WESTFIELD, MASS.—The voters will probably be asked to appropriate $4,000 for work at Shatterack Pond, in Montgomery.

WOONSOCKET, R. I.—Byron I. Cook, Supt., has had a company of surveyors in North Smithfield laying out proposed sites for the new reservoir, according to reports.

JEWETT CITY, CONN.—Reports state that the citizens have voted in favor of works.

RIDGEFIELD, CONN.—Jas. E. Walsh, Danbury, is reported as interested in proposed works.

ROCKVILLE, [illegible].—The Rockville Water & Aqueduct Co. has purchased land for a high pressure reservoir.

ALBANY, N. Y.—The board has submitted its report to the council recommending the proposed supply from Kinderhook Creek; estimated cost, revised plan, $1,372,455.

BABYLON, N. Y.—The Sumpawams Water Co. is reported as proposing to increase its capital stock from $25,000 to $40,000.

KINGSTON, N. Y.—The contest between the city and Kingston Water Co. has been renewed and the prospect that the city will build works is said to be improving.

MOUNT VERNON, N. Y.—The Mount Vernon Water Co.'s plant has been purchased by a syndicate represented by Wm. Underwood, 40 Wall St., New York, according to reports, at $900,000. The new company has contracted with H. J. Riley, 31 Broadway, New York, for two reservoirs near Pelhamville, and the construction will be commenced at once.

NEWTOWN, N. Y.—Residents of Laurel Hill are negotiating with the Citizens' Water Supply Co. for a supply. The extension would cost about $12,000.

NEW YORK, N. Y.—The department of public works will receive bids until Feb. 6 for cast iron pipe and specials, hydrants, stopcocks, lead, lead pipe, tapping cocks, hydrant nozzles, etc.

NORTH TONAWANDA, N. Y.—E. C. McDonald is a member of a committee appointed to negotiate for the purchase of the plant on Tonawanda Island.——A board of water commissioners will soon be appointed. pointed.

PORT JERVIS, N. Y.—At a public meeting Jan. 11 it was voted to petition for an election to vote on the question of municipal ownership of the works. New works are estimated to cost about $208,000, and the present works are valued at about half that sum, but would require nearly $100,000 of improvements.

RIVERHEAD, N. Y.—Davis & Co., Port Jefferson, are said to have contracted to sink an 8-in. well for the works.

SYRACUSE, N. Y.—An issue of $500,000 of water bonds has been authorized by the council.

TONAWANDA, N. Y.—Bids are asked until Feb. 3 for labor and material for certain extensions. A. Ultsch, Secy. Comrs.

NEWARK, N. J.—The lowest bid for the new storage reservoir on Ivy Hill, South Orange, was that of Robt. T. Broadhead, Flemington, at $808,923.

ALTOONA, PA.—G. V. Gardner, Pres. Juniata Water Co., writes us that bids will be opened about April 1 for the proposed works; supply from mountain stream; population, 3,000.

BEAVER FALLS, PA.—The council has voted in favor of a loan of $125,000 for building new works. Much opposition is reported.

FACTORYVILLE, PA.—It is reported that works will soon be put in.

HASTINGS, PA.—The Hastings Water Co. has offered to sell its plant to the borough for $7,000, according to reports.

HELLERTOWN, PA.—The citizens are talking of building a reservoir for fire protection.

LOYALSOCK, PA.—The Summit Water Co. has been incorporated to secure a supply for this township. The supply will be from artesian wells, and it is stated that the construction of a reservoir will be commenced as soon as possible; capital stock, $10,000; Treas., Chas. A. Bowman, Williamsport.

MEADVILLE, PA.—The city engineer and two members from each branch of councils have been appointed to secure plans and estimates for a system. The present works were built in 1875 by the Meadville Water Co.

PITTSBURG, PA.—The Monongahela Water Co. will probably lay about 10 miles of mains this year in Crafton, Mansfield, Chartiers, Ingram and Idlewood. The supply will be from wells under the bed of the river at Brunot's Island.

WAYNE, PA.—Surveys have been made by the Wayne Water Co., according to reports, for laying mains to supply Malvern, Paoli, Berwyn, Duffryn Mawr, Narberth, Ardmore and Bryn Mawr.

SNOW HILL, MD.—Wm. S. Wilson and J. P. Moore are members of the recently appointed water committee. Works including stand-pipe are proposed.

WEST POINT, VA.—The legislature has authorized an issue of bonds for works.

MOUNDSVILLE, W. VA.—Col. Benj. Wilson is reported as stating that the works will be built as soon as possible.

WESTON, W. VA.—It is reported that steps are being taken to organize a private company to put in works.

WHEELING, W. VA.—G. M. Varney, Supt., writes us that an 8-in. main will probably be extended to Fulton, about 5,000 ft., in the spring, the work to be done by the city.

ATLANTA, GA.—The commissioners wish $75,000 for extensions this year.

CONGERS, GA.—Works are contemplated, according to reports.

GRIFFIN, GA.—It is stated that the Griffin Consolidated Light & Water Co. is planning to build a stand-pipe.

PERRY, GA.—The citizens are discussing the construction of works.

MADISON, FLA.—An election will be held Feb. 6 to vote on an issue of bonds for $16,000 for building works.

MILTON, FLA.—The question of securing works continues to be agitated, according to reports.

TALLAHASSEE, FLA.—It is reported that a 400,000-gallon stand-pipe will be erected.

COLUMBIA, ALA.—Negotiations are being made for a system, according to reports.

UNION SPRINGS, ALA.—The citizens are reported as considering the question of works.

DONALDSONVILLE, LA.—Steps are being taken to improve the works.

MARTIN, TENN.—It is stated that works would probably have been put in had it not been for the financial stringency. The question is now being considered.

FRANKLIN, KY.—The contract for works has been awarded to W. R. Bush, Lake City, Fla.

MOUNT STERLING, KY.—Surveys are being made for the proposed works. A reservoir will probably be constructed about six miles from the city.

ATHENS, O.—The citizens have voted, 438 to 24, in favor of works, and the contract awarded to Stevens & Bedwards, according to reports.

BARBERTON, O.—We are informed that the contract for works has been awarded to Murphy & Coone, and sold by them to Collins & Kennedy, Carbondale, Pa.; contract price, $9,223.

CLEVELAND, O.—Bids are asked until Feb. 16 for 262 fire hydrants, 459 water gates, 3,900 ft. of 36-in. pipe and 6,400 ft. of smaller sizes. J. H. Farley, Dir. Pub. Wks.

COLUMBUS, O.—Three bids were received for increasing the East Side supply. Jas. G. Pulling would sink 24-in. wells, each 70 ft. deep, guaranteeing 6,000,000 gallons per day, for $24,975; E. A. Stimson, four propositions, $32,287 to $43,714; Wagner Water Supply Co., 6-in. wells, $25,000; in each case the city to furnish the ground free of expense.

CONTINENTAL, O.—A committee has been appointed to locate a well, hydrants, etc., and to estimate the cost.

EAST LIVERPOOL, O.—The council is reported as having completed arrangements for the construction of a 15,000,000-gallon reservoir, to cost about $30,000.

GALLIPOLIS, O.—H. D. Summers, Cy. Clk., writes us that plans have been prepared by S. M. Gray, Providence, R. I., and that bids will be asked for the construction as soon as bonds are sold on Feb. 15; supply from river; population, 6,200.

JEROMEVILLE, O.—An election will be held Feb. 14 to vote on the question of works.

NAPOLEON, O.—The contract for works and an electric light plant has been awarded to Edward Sykes, Minneapolis, who will accept in payment the $60,000 of bonds recently noted.

ST. BERNARD, O.—An election will be held Feb. 24 to vote on an issue of $85,000 of bonds for works and an electric light plant; estimated cost of works, $60,000, and of electric light plant, $18,000; Engr., Geo. Hornung, Cincinnati; Henry N. Nurre, Cy. Clk., P. O., Ludlow Grove.

SANDUSKY, O.—The question of issuing $30,000 of bonds for extensions will probably be voted upon at the next municipal election.

STEUBENVILLE, O.—We are informed that no election has yet been held to vote on the question of new works, noted Jan. 11.

WAPAKONETA, O.—A well has been sunk and reports state that works will soon be put in.

WINTON PLACE, O.—The citizens have voted, 82 to 32, in favor of issuing $25,000 of bonds for works; supply from Cincinnati; plans and specifications in preparation; population, 1,500. Engr., E. F. Layman, 64 West 3d St., Cincinnati.

EVANSVILLE, IND.—The award of prizes for successful plans for works was noted on our first page last week. It is stated that about $50,000 of 30-in. pipe will probably be laid at once.——Bids are asked until Jan. 29 for a supply of 20 to 6-in. pipe. A. H. Foster, Clk. Bd.

HAUGHVILLE, IND.—The Indianapolis Water Co. is negotiating to supply this place. About 12 miles of main would be required, of which about two miles of 10-in. main would be laid at once.

HOUGHTON, MICH.—The recorder has been directed to ask for bids for the construction of a tank or reservoir near the present one.

MARSHALL, MICH.—At an election Jan. 15 the citizens voted by 600 majority to issue $50,000 of bonds for the construction of new works, according to reports.

SAGINAW, MICH.—W. R. Coates has been consulted with regard to improving the supply.

ATHENS, ILL.—It is stated that works will be put in.

EDWARDSVILLE, ILL.—The city will award a franchise to parties willing to put in works. W. H. Hall, Mayor.

FLANAGAN, ILL.—A new engine, boiler and pumps will be added, according to reports.

OTTAWA, ILL.—The clerk has been authorized to ask for bids for works to be owned by the company bidding. A 30-year franchise would be granted and 100 hydrants rented by the city if 20 miles of mains are laid; bids to be opened Feb. 13.

PANA, ILL.—Bids are asked until Feb. 12 for works, as stated in our advertising columns. A. B. McMillen, Cy. Clk.

QUINCY, ILL.—The council is reported to have voted, 8 to 4, to go ahead with the plans for building works to be owned by the city.

SPRING VALLEY, ILL.—It is reported that $10,000 has been appropriated for works.

TREMONT, ILL.—The Tremont Water-Works Co. has been incorporated with a capital stock of $5,500.

REEDSBURG, WIS.—Bids will soon be asked for works and an electric light plant, according to reports.

CLEAR LAKE, IA.—The council is reported as talking of putting in works.

MONTEZUMA, IA.—A petition is being circulated for works.

DAKOTA, MINN.—Reports state that works may be put in next summer.

DULUTH, MINN.—The $800,000 of water bonds have been sold to the Duluth Trust Co.

OSWEGO, KAN.—The Oswego Water-Works Co. has been incorporated by David Jennings, O. W. Ball, T. C. Babb, A. D. Carpenter and B. F. Harrison; capital stock, $50,000.

HEMINGFORD, NEB.—Bids are asked until Feb. 3 for a stand-pipe, 10 × 100 ft., 4,000 ft. of 6-in. main and a vertical pumping engine; supply from tubular well; population, 400. I. E. Tash, Clk. B. F. Jones, Chn. Bd.

HURON, S. DAK.—The Huron Water-Works Co. has contracted with E. A. Swan for an 8-in. artesian well to be sunk 1,050 ft. deep with possibly an additional 200 ft. of 6-in.

BRUNSWICK, MO.—The citizens have voted to issue $10,000 of bonds for works and an electric light plant.

KIRKSVILLE, MO.—The citizens have voted, about 16 to 1, to issue $20,000 of bonds to construct works.

LOUISIANA, MO.—The Louisiana Water Co. has increased its capital stock from $100,000 to $150,000. Pres., S. B. Culver; Secy., J. W. Matson.

ALEXANDRIA, ARK.—Reports state that a new reservoir is to be constructed.

CRAWFORD, TEX.—The Crawford Water-Works Co. has been incorporated by A. A. McNeill, Frank Kell and F. Gibbs, all of Bosque county; capital stock, $5,000.

GAINESVILLE, TEX.—The council is considering a scheme for obtaining a supply from artesian wells.

HEWITT, TEX.—J. A. Warren and M. R. Chapman are interested in a company that is reported as about to secure an artesian supply.

KERRVILLE, TEX.—It is reported that works may be put in.

WAXAHACHIE, TEX.—The city has contracted for a temporary supply, according to reports.

WEST, TEX.—The West Water, Light & Electric Co. is being organized with a proposed capital stock of $50,000 to put in works. Address W. H. Useary.

BOULDER, COLO.—The contract for the new mountain pipe line has been awarded to Luther Hixon, Henry Johnson and Jos. McCabe, Boulder, at $25,889. The work includes 800 ft. 20-in. pipe, 8,050 ft. 16-in. and relaying 5,000 ft. 8-in. pipe.

PUEBLO, COLO.—It is reported that the Colorado Fuel & Iron Co. will soon build a large reservoir on the west side of Lake Minnequa, near this city.

HOQUIAM, WASH.—Bids will be received as soon as the $24,000 of bonds are sold, for a pumping engine, pipe, hydrants and reservoir; supply from creek; population, 2,000. O. P. Burrows, Cy. Engr.

WALLA WALLA, WASH.—The city clerk will receive bids until Jan. 30 for $161,000 of water bonds for the construction of new works.

HOOD RIVER, ORE.—The Hood River Hydrant Co. has been incorporated by H. C. Coe, A. S. Blowers and J. H. Cradlebaugh, owners of the present works; capital stock, $20,000.

TILLAMOOK, ORE.—E. N. Drew, Recorder, writes us that the question of works was defeated at the recent election.

ALAMEDA, CAL.—J. W. Goodwin represents a company which has offered to furnish a daily supply of 30,000,000 gallons of salt water for street sprinkling for $7,000 a year.——The Artesian Water Co. is reported as having purchased land and about to award contracts for 40 artesian wells to secure a supply of 2,400,000 gallons per day.

COLTON, CAL.—The question of municipal ownership of works continues to be agitated, and it is reported probable that bonds will be voted for the construction of a new system.

FRESNO, CAL.—The Fresno Water Co. contemplates extensions of 10 to 6-in. mains in several streets and putting in 40 additional hydrants, according to reports. Pres., J. J. Seymour; Secy., J. M. Collier.

LONDON, ONT.—Bids are asked until Jan. 29 for steam pumping machinery. J. M. Moore, Engr.

CAMPBELLTOWN, N. B.—Negotiations are being made with Raoul Rainfret, representing Montreal capitalists, for a supply for fire protection.

DIGBY, N. S.—The question of works is being agitated, probably owing to a recent fire.

ARTESIAN WELLS.

ALPENA, S. DAK.—It is reported that farmers in the southern part of this (Jerauld) county have united for the purpose of sinking an artesian well.

ONIDA, S. DAK.—Chas. Holmes, Clk., writes us that an election will be held Jan. 27 to vote on an issue of bonds for a 6-in. artesian well, after which bids will probably be asked for its construction.

BIG SPRINGS, TEX.—The commissioners' court has donated $1,000 to aid the citizens to deepen the artesian well, which is now 740 ft. deep.

ALAMEDA, CAL.—The artesian Water Co. is reported as about to contract for 40 wells.

IRRIGATION.

WICHITA, KAN.—P. J. Bonebrake, Topeka, has been appointed receiver of the corporation owning the Eureka ditch, extending from Ingalls, Gray county, to Kinsley, Edwards county. The ditch is bonded for $100,000.

DENVER, COLO.—The following bids were received by the state engineer for the construction of the proposed Saguache reservoir: W. E. Dodge, $27,259; R. S. Fuller, $27,400; G. W. Wilson, $29,500; A. Christianson, $31,175.95; D. McShane, $38,579.50; P. Mulvaney, $44,792; James H. Barry, $48,000.

STOCKTON, CAL.—The San Joaquin Land & Water Co., after six years of litigation among the stockholders, has elected a board of directors who propose to complete the project of the company. About $207,000 has already been spent and $400,000 will be required to complete the work. The directors include Col. G. R. Sperry, W. C. White, Chas. Belding and R. E. Wilhorh.

ARIZONA.—The Consolidated Canal Co. is undertaking the irrigation of a large tract of country south of the Salt River, at an expenditure of about $1,000,000. It is stated that about 110,000 acres of level alluvial land, with 10 to 25 ft. of soil, have already been brought under cultivation. A Marion ditching dredge has been used in enlarging old ditches, working in cemented gravel, loose rock, sand and earth, with large cottonwood, mesquite and willow stumps to be removed. A larger dredge is to be built. D. M. Ferry, C. C. Bowen and D. A. J. Chandler, Detroit, Mich., are interested.

MEXICO.—Reports from the city of Mexico state that an important concession has been signed by the Mexican government with Senor Francisco Espinosa, giving control of all the water flowing out through the great canal and five-mile tunnel now being constructed at a total cost of many millions of dollars for the drainage of the Valley of Mexico. The use of this immense volume of water, as stated in the contract, is for irrigation uses in the states of Mexico and Hidalgo to the north of the valley. The works will be completed in less than two years.

NEW COMPANIES.—South Platte Canal & Reservoir Co., Pueblo, Colo.; $500,000; to do business in Douglass, Jefferson, Arapahoe and Weld counties; D. H. Moffat, W. S. Cheeseman, Thos. S. Hayden, C. T. Allen.——International Canaigre Co., Chicago, Ill.; $10,000,000; to operate and maintain reservoirs, canals, ditches, water rights, etc., construct railways, public works, etc.; B. D. Thorner, Geo. H. Tousey, Elisha M. Sanford.——Clark's Fork & Bridger Ditch Co., Clark's Fork, Mont.; $10,000.——Big Horn Basin Colonization & Irrigation Society, Omaha, Neb.; $252,000.——Yulupa Land & Water Co., Sacramento, Cal.; $90,000.

SEWERS.

MANCHESTER, N. H.—Bids are asked by the street commissioners until Jan. 27 for a supply of sewer pipe.

NEWPORT, N. H.—E. Gustine & Son, Keene, are expected to complete plans for a system this week.

LYNDONVILLE, VT.—The citizens have voted to have surveys made for a sewer in East St.

ANDOVER, MASS.—McClintock & Woodfall, Boston, are preparing plans for a system.

BROCKTON, MASS.—F. Herbert Snow, Cy. Engr., informs us that the contract for furnishing and setting up ready for operation two triple-expansion sewage pumping engines of 5,000,000 gallons capacity each, with boilers and all accessories, was awarded by the sewerage commissioners Jan. 20 to the Knowles Steam Pump Co., at $19,386. The detailed bids were published in our issue of Dec. 14.

SPENCER, MASS.—Reports state that the town engineer is preparing plans for sewage disposal works.

WALTHAM, MASS.—The legislature will be petitioned for authority to issue bonds for $50,000 for the proposed sewer to Roberts.

WESTBORO, MASS.—The town has voted to issue $5,000 of 4% bonds for sewers.

WOBURN, MASS.—The sewerage commissioners have asked for an appropriation of $130,000 to commence the construction of a system in the spring.

MOUNT VERNON, N. Y.—The council has authorized an issue of $25,000 of sewer bonds, bids for which will be opened Feb. 20.

NEW ROCHELLE, N. Y.—The commissioners are reported to have purchased land for proposed sewage disposal works.

SYRACUSE, N. Y.—The city engineer has made surveys for a system, according to reports, and an expert is to be appointed by the mayor to examine the plans.

JERSEY CITY, N. J.—Bids are asked by the board of street commissioners until Feb. 5 for 2,850 lin. ft. 42 to 24-in. brick and 6,570 lin. ft. 12 to 18-in. pipe sewer; also for 665 lin. ft. of 24-in. oval brick sewer. It is reported that work will be commenced about May 1 on a sewer in the West Side section of Greenville, which it is expected will require two years to build.

ALLEGHENY, PA.—Contracts have been awarded as follows: Standard Construction Co., at $118,730; Sloan & McIlwain, at $115,925 and $83,215. The bids were published Jan. 11.

MONONGAHELA, PA.—An election is to be held to vote on an issue of $20,000 of bonds for completing the system and for paving streets.

PHILADELPHIA, PA.—The council has ordered the construction of sewers in over 40 streets.

WILLIAMSPORT, PA.—S. M. Gray has reported in favor of the plans prepared by C. P. Bassett.

BALTIMORE, MD.—The mayor states that a bill will be introduced in the legislature giving the city authority to secure a system. It has not been decided whether the city will do the work, which will cost several millions of dollars, or will grant a franchise.

ATLANTA, GA.—The contract for constructing sewers for five years has been awarded to W. D. Palmer, of the Collins Brick Co.

OWENSBORO, KY.—The mayor has recommended that a consulting engineer be employed to assist the city engineer to prepare plans for certain work.

SANDUSKY, O.—Plans have been prepared for sewers in two streets.

JEFFERSONVILLE, IND.—The city engineer has prepared plans for a 4-ft. brick sewer estimated to cost $13,000.

PERU, IND.—Plans will probably be prepared for a system.

BIG RAPIDS, MICH.—Plans for a system have been completed, according to reports.

QUINCY, ILL.—It is stated that about three miles of sewers will be constructed this season.

KENOSHA, WIS.—The council is reported as to continue the sewer extensions to give work to the unemployed.

MADISON, WIS.—The council is considering plans for sewage disposal works; estimated cost $25,000 to $75,000.

NEENAH, WIS.—The city engineer is preparing plans for a complete system.

PORTAGE, WIS.—The mayor has sent a petition to the council urging the adoption of a system before the streets are paved.

DES MOINES, IA.—R. B. Dennis, Cy. Clk., informs us concerning the 19 miles of sewers noted in our issue of Jan. 11 that 14 miles are now under contract, and that the other five have not yet been ordered by the council.

KEOKUK, IA.—The council has authorized the city engineer to make plans for sewers in two streets.

SIOUX FALLS, S. DAK.—It is reported probable that the construction of a complete system will be commenced next month, the work to be done by the city; estimated cost, $100,000. D. L. McKinney, Chn.

STREETS.

FLATLANDS, N. Y.—Bids are asked until Jan. 29 for grading Avenue L. F. K. Castner, Counsel.

SYRACUSE, N. Y.—Bids are asked until Jan. 29 for paving with Trinidad asphalt and vitrified brick. H. F. Stephens, Cy. Clk.

JERSEY CITY, N. J.—Bids are asked by the board of street commissioners until Feb. 5 for improving Whiton St., the work including 2,350 sq. yds. stone paving, 1,230 lin. ft. curbing, 50 cu. yds. rock excavation, and 800 cu. yds. earth excavation.

PATERSON, N. J.—The board of public works has decided to macadamize several streets, estimated to cost $15,000, to give work to the unemployed.

DARBY, PA.—Bids are asked until Feb. 5 for macadamizing Spruce St. Geo. Hilton, Chn. Com.

WAYNESBORO, PA.—The council has voted in favor of $15,000 of bonds for streets.

TAVARES, FLA.—An election will be held in March to vote on an issue of bonds for $4,500 for street improvements.

AKRON, O.—Bids are asked until Feb. 17 for paving four streets with brick. F. C. Wilson, Clk. Cy. Comrs.

CINCINNATI, O.—The board of administration will receive bids until Feb. 16 for macadamizing South Elm St., and until Feb. 14 for paving Ohio Ave. with asphalt.

SANDUSKY, O.—The city engineer has been directed to prepare plans for paving several streets.

LANSING, MICH.—The council has instructed the board of public works to investigate the question of street paving, and it is reported that a large amount of paving will be done next season.

CHICAGO, ILL.—The gas and street railway companies have agreed to pay for repairs made on their account during the coming season. The superintendent of streets is reported as finding that there is $400,000 of this work to be done.

LINCOLN, ILL.—Bids are asked until Feb. 19 for paving certain streets.

QUINCY, ILL.—Bids are asked until Jan. 30 for two stone and two brick culverts. John R. Nevins, Secy. Bd. Pub. Wks.——The council has ordered paving estimated to cost about $80,000.

ROCK ISLAND, ILL.—The street committee has decided to recommend about 20 blocks of brick paving for next season.

BOONE, IA.—Bids are asked until Feb. 14 for paving certain streets, as stated in our advertising columns. J. L. Hull, Cy. Clk.

ST. LOUIS, MO.—The board of public improvements is considering ordinances for paving several streets with asphalt and granite.

ELECTRIC LIGHT AND POWER.

BALLSTON SPA, N. Y.—The Ballston Spa Electric Light & Power Co. is reported as contemplating putting in an additional engine and dynamo.

PHILADELPHIA, PA.—Petitions are being circulated for a municipal electric light plant.——The Powelton Electric Light Co. has voted to increase its capital stock from $300,000 to $450,000 for extensions.

READING, PA.—It is stated that R. N. Carson, R. N. Buddey, Philadelphia, and J. A. Rigg and R. L. Jones, this city, will apply for a charter for the Metropolitan Electric Co. to furnish power to the Reading Traction Co.

WILKES BARRE, PA.—The Anthracite Light, Heat & Power Co. is being organized by W. S. Mears, T. A. Simpson and others to furnish electric light and power in Plains, Miner's Mills and Parsons.

OPELICA, ALA.—The Opelica Electric Light & Power Co. wishes to purchase an alternating incandescent dynamo of 750 to 1,000 lights.

ROCK CREEK, O.—There is talk of utilizing water power near the village for an electric light plant.

KALAMAZOO, MICH.—The lowest bid received for lighting the city was 45 cts. a night for each all-night arc light and the council is reported as having voted in favor of a municipal plant.

GRAFTON, WIS.—It is reported that an electric light plant is to be put in near this village to light several villages in this vicinity; water power would be used.

WATERVILLE, KAN.—The citizens are proposing to put in a plant to furnish electric light to this place and Blue Rapids, according to reports.

FREMONT, NEB.—The preliminary report on the canal project estimates the cost at $225,000, with 7½% interest guaranteed from the start for the electric power to be furnished to the manufacturing industries already under way.

ST. CHARLES, MO.—A franchise for an incandescent electric light plant has been granted to Albert Spiers.

WACO, TEX.—The council has voted to receive bids for 30 days from March 28 for lighting the city after March 28, 1895.

SUTTER CREEK, CAL.—J. S. Emery and Abner Dobie, San Francisco, are interested in a proposed electric plant to supply light and power to this place, Jackson and Amador City, as well as for a proposed electric railway to be built in the county.

NEW COMPANIES.—People's Light & Power Co., Newark, N. J.; $2,000,000; J. K. Corbiere, Caldwell; J. L. Munn, J. E. Reynolds, East Orange; and others. ——Chicago Electric Co., Chicago, Ill.; $1,000,000; W. M. Lenbart, J. W. Alderman, E. S. Norton.——New Automatic Light Co., Willimantic, Conn.; $6,000.——Electrical Power Co., Sterling, Kan.; $10,000; J. H. Ricksecker, J. M. Hershbarger, T. A. Watson, Kansas City, Mo.; M. T. Stout, Sterling.

CONTRACT PRICES.

CRUSHED STONE.—Easton, Pa.—H. R. Fehr, Cy. Engr., informs us that the only bid for crushed stone was that of J. E. Miles, at $1.18 per ton for limestone delivered on the street and $2.05 for traprock. The contract was not awarded. Last year the city paid $1 per ton.

GRADING.—Washington, D. C.—The following bids were received for grading North Capitol St., between T and Michigan Ave: Wm. E. Chaffee, 15½ cts. per cu. yd.; M. F. Talty, 18 cts.; P. F. Cogan, 18 cts; Geo. Killeen, 18½ cts.; Washington Asphalt Block & Tile Co., 18½ cts.; Albert Gleason, 22¼ cts.

EXCAVATING.—Kansas City, Mo.—The contract for removing 3,040 cu. yds. of earth and 5,200 cu yds. of rock from the bluff in Eleventh St. has been awarded to Wm. Powell, at $1,412, being 42½ cts. per cu. yd. for the earth and 1 ct. for the rock. The next lowest bid was at $2,620 and the highest, $6,480. Mr. Powell expects to realize a profit from the sale of broken rock, according to reports.

HIGHWAYS.—Jersey City, N. J.—The freeholders of Hudson county received the following bids Jan. 18 for placing 1,500 cu. yds. of crushed stone on the Newark and New York turnpike from the Hackensack River to the easterly end of Harrison Ave., Harrison; Henry Byrnes, $1.79 per cu. yd.; John Tully, $1.08; Patrick Burns, $1.05; Jos. Waddington, $1.65; Michael Feeley, $1.40; Wm. Becker and John Wetherly, $1.45; Thomas Fallon, $2.03; David Kerr, $2.15; Daniel Moore, $2.25; M. McGovern, $1.41.

HYDRANTS AND SPECIAL CASTINGS.—Washington, D. C.—The following bids were received Jan. 20 for fire hydrants: Camden Iron Wks., Philadelphia, $40 each, or $34 without supplemental valves; E. L. Dent, Georgetown, $44.95; M. J. Drummond, New York, $43; A. H. Haig, Philadelphia, $43.48; Howard Iron Wks., Buffalo, $37.75 for 4-ft. or $40 for 5-ft., informal. The bids for special castings were: Builders Iron Foundry, Providence, $2,400 for globe castings, according to list furnished; E. L. Dent, 2½ cts. per lb.; M. J. Drummond, 2 3-16 cts.; W. H. March, Philadelphia, 1.89 cts.

ELECTRIC LIGHTING.—Pasadena, Cal.—The council has contracted with the Pasadena Electric Light & Power Co. for street lighting, the bid being as follows: For 50 arc lights of 2,000 c. p. each, for 1 year at $11 per light per month; 2 years, at $10.50; 3 years, at $10 with 10 or more additional lights at same price. The lights are to burn until 1 a. m., and the service may be extended all night by an additional payment of 75 cts. per light per month. The council has the privilege also of adding 10 more 1,200-c. p. lamps at any time at $9.50 each per month.

HYDRANTS AND WATER GATES.—Seattle, Wash. —The following bids were received for hydrants and water gates, 50 of each: Collins & Losier, Seattle, hydrants, $37, gates, $15; Z. C. Miles Co., Galvin make, for both, $57.50, Ludlow make, $64.25; Moran Bros., hydrants, $26, gates, $13.72; Washington Iron Wks., $28.75 and $12.50; Vulcan Iron Wks., $19.25 and $10.75; Dwyer Bros., $66.15 and $57.75; Crane Co., $18.55 and $5.45; Charles Power, $48 and $17.50; John A. Gregg, Bay City, Mich., hydrants, $25; Rensselaer Mfg. Co., Troy, N. Y., gates, $14.20; Michigan Brass & Iron Wks., Detroit, for both, $55.15 (awarded contract); Kelly & Jones Co., Pittsburg, gate valves, $10.

RESERVOIR.—Newark, N. J.—Chas. E. A. Jacobsen, Engr., informs us that the following bids were received Jan. 17 for the proposed storage reservoir on Ivy Hill in South Orange.

Quantities.	R. P. Broadhead, Flemington, N. J.	T. M. Lesher & Son, Easton, Pa.	P. Vanderhoof & Son, Newark, N. J.	Smith & McCormick, Easton, Pa.	R. A. Malone & Co., Philadelphia, Pa.	T. C. O'Reilly & Son, Orange, N. J.	Thos. J. Regan, Newark, N. J.	Sanford, Stillman & Co., Newark, N. J.
Earth excavation, 475,000 cu. yds.	$.26	$.52	$.50	$.38	$.35	$ 32	$.50	$.35
Rock " 120,000 "	.58	.60	1.10	85	.75	.69	2.50	1.35
Concrete, stone on ground, 22 500 cu. yds.	4.13	4.50	4.90	4.10	4.75	4 00	4.25	4.62
" stone from el ewhere, 20 0.0 cu. yds.	6.13	5.00	5.40	4.50	5.25	6.00	5.50	5.75
Masonry, Portland cement, 500 cu. yds	2.00	5.00	6 75	6.50	1.30	2.00	10.00	2.50
Asphaltic cem. and felt lining, 1,510,000 sq. ft.	.04¼	.06	.04½	.04	.04	.04	.05	.03
" " filling, 4,4·0 lin. ft.	.07	.10	.06½	.06	.06	.06	.07	.05
Brick pav. in bottom, grouted, 130,000 sq. yds.	.51	.45	.68	.61	.65	.68	.05½	.60
" " in slope, in mortar, 40,000 " "	1.05	1.07	.95	1.19	1.20	1.25	.60	1.00
Brickwork, 300 cu. yds	10.00	8 00	.92	9.75	15.09	10.00	10.00	9.00
Bluestone capping, 1,9.0 lin. ft.	1.00	.34	.32	.25	.60	.35	.40	.50
Rubble masonry, 300 cu. yds	4.30	3 50	6.00	6 50	6.00	7.00	5.00	5.75
Pipes and specials, built in, 200 tons	10.00	7.50	2.00	5 00	5.00	10.00	10.00	10.00
Walk on bank, 5,000 lin. ft.	.30	.10	.12	.10	.10	.50	.30	.35
Fence, 3,500 lin. ft.	.96	.87	1.25	1.00	.80	.75	.75	.90
Soiling and seeding, 51,000 sq. yds.	.10	.10	.08	.16¼	.10	.08	.20	.15
Total bids	$868,923	$732,091	$801,360	$680,851	$682,179	$664,384	$859,368	$735,195

SEWERS.—Milwaukee, Wis.—The contract for constructing a sewer 10 ft. in diameter in St. Paul Ave., from Delaware Ave. to Lake Michigan, was awarded to John J. Crilley, at $18.94 per lin. ft., the other bids being Henry Vogt, $27; E. Bowler, $28; Geo. J. Markey, $29.56; Wm. Forrestal, $25.75; Jas. O'Donnell, $26.80. The contract for the Deer Creek outlet sewer, 6 ft. diameter, has been awarded to J. J. Crilley, at $8.16, the other bids being Henry Vogt, $24.75; Geo. E. Zimmerman, $9.47; Jacob Werner, $9.40; Jas. Markey, $10.49; Wm. Forrestal, $12.80; E. Bowler, $9.78; Jas. O'Donnell, $17.50; R. J. Wilson, $8.70; D. O. Driscoll and Thos. Morrissey, $10.50; David Turner, $10.48. All the bidders are residents of Milwaukee. G. H. Benzenberg, Cy. Engr.

PUBLIC LIGHTING.—Brooklyn, N. Y.—The following bids have been received for electric lights for 1894: Citizens' Electric Illuminating Co., 1,200-c. p. arc lights, 39½ and 50 cts. per light per night; 25-c. p. incandescent lights, 10 cts.; 32-c. p., 12¾ cts.; 50-c. p., 20 cts.; 65-c. p., 23 cts.; 75-c. p., 25 cts.; mast arms, $20 each. Municipal Electric Light Co., prices same as preceding except for incandescent lights, 20 cts. per 1,000 volts. Edison Electric Illuminating, 1,200-c. p. arc lights, 45 cts.; 600-c. p. arc lights, 22½ cts. each cross street suspension lamp, $5 per year extra; 16-c. p. incandescent, meter measurements, 1 ct. per hour.——For illuminating gas the bids were: Williamsburgh Gaslight Co., $20 per year per lamp and $1.25 per 1,000 cu. ft. for public buildings; Brooklyn Gaslight Co., $19.80 and $1.25; Metropolitan Gaslight Co., $20 and $1.25; Nassau Gaslight Co., $20 and $1.25; Peoples' Gaslight Co., $20 and $1.25; Citizens' Gas Co., $20, except in ward 26, $25 and $1.25.

STREET SUPPLIES.—Detroit, Mich.—The following bids have been received for annual contracts: Cement—Milwaukee Cement Co., 57 cts. per bbl., with 8 cts. rebate on empty sacks. Plank, common lumber and scantling—Loomer & Hawley, $13.95 for 2½-in. Norway pine plank; Chas. W. Ristrick, $12.95 for 2-in. same; W. A. Miller, $10.98 for hemlock dressed plank; C. W. Ristrick, $13.35 for 2½-in. crosswalk plank; Hannon & Springer, $10.90 for hemlock scantling; C. W. Ristrick, $12.70 for common lumber; W. A. Miller, $16 for white pine plank and timber. Sewer grates—For round locking sewer grates, Co-operative Foundry Co., $3.50 each; receiving basin covers, same, $1.75 each; horse drinking fountains, same, $39.75 each, and Griffin Car Wheel Co., $40, allowing $13 per gross ton for old iron; locking manhole covers, Griffin Car Wheel Co., $1.50 each. Receiving basins—Young & Smith and Ortman & Groat, Euclid blue stone, $23.50. Rewiring city hall for electric lighting—Electric Supply & Engineering Co., $1,040, or about $1,000 lower than any other bidder.

MISCELLANEOUS CONTRACTS AND SUPPLIES.

BONDS.—South Orange, N. J.—The village has sold $20,000 of bonds for the erection of a town hall, at a premium of 1.27%.

WATER TOWER.—Springfield, Mass.—The fire commissioners have petitioned for $9,000 for a water tower and new steam fire engine.

DAM.—Detroit, Mich.—Bids will be received at the U. S. Engineer Office until Feb. 5 for constructing a clay dam at the end of the 800-ft. lock at St. Mary's Falls Canal. Col. O. M. Poe, U. S. A.

BOILER.—San Francisco, Cal.—The contract for a new boiler for the steamer "Rush" has been awarded by the Revenue Marine Service to the Fulton Engineering & Shipbuilding Wks., San Francisco, at $11,368, the other bids being P. F. Dundon, $12,437, or $11,847 for a Dundon patent boiler; Golden Gate & Miners' Iron Wks., $12,900; Risdon Iron & Locomotive Wks., $12,000, all of this city, and the Union Iron Wks., Oakland, $12,990.

INDUSTRIAL NOTES.

THE CANADIAN ENGINE WORKS CO., of Kingston, Ont., has an order for two ten-wheel engines for the Intercolonial Ry.

THE WELLS & FRENCH CO., of Chicago, Ill., has an order for 200 refrigerator cars for the Armour Packing Co.

THE BARNEY & SMITH CAR CO., of Dayton, O., is building 100 dump cars for the Baltimore & Ohio Southwestern R. R.

THE OHIO FALLS CAR CO., of Jeffersonville, Ind., is building a number of vestibuled day cars for the Chicago & Grand Trunk Ry.

THE JACKSON & SHARP CO., of Wilmington, Del., will undertake the manufacture of street cars in addition to railway cars.

THE SCHENECTADY LOCOMOTIVE WORKS, of Schenectady, N. Y., have orders for three switch engines for the New York Central R. R., and two for the Central Vermont R. R.

THE LARAMIE ROLLING MILLS, of Laramie, Wyo., have the contract for angle bars for the new steel rails recently ordered by the Union Pacific R. R. from the Colorado Iron & Fuel Co.

THE BALDWIN LOCOMOTIVE WORKS, of Philadelphia, Pa., have built 22 ten-wheel engines for the New York, Pennsylvania & Ohio R. R., with cylinders 20 × 24 ins., and having driving wheels 5 ft. 8 ins. diameter.

THE BUCKEYE ELECTRIC CO., of Cleveland, O., is making a new incandescent lamp in which the platinum leading-in wires are omitted, the glass stem of the filament being treated so as to form the conductor from the exterior wires to the filament.

THE WESTINGHOUSE ELECTRIC & MFG. CO., of Pittsburg, Pa., reports good business for 1893. Since the close of the Columbian Exposition it has taken out the electric lighting plant and sold it to different lighting companies. Besides extensive work for power and light plant the company has the contract for the Niagara Falls power plant.

JOSEPH G. FALCON, Evanston, Ill., has completed his contract for the Highland Park water-works, including a well 16 ft. diameter and 20 ft. deep, laying a 16-in. intake pipe into Lake Michigan 2,085 ft., and putting in a strainer on the pipe in 20 ft. of water. About 40 Falcon flexible ball joints were used on this pipe line.

THE NATIONAL ELECTRIC HEADLIGHT CO., of Indianapolis, Ind., has its electric headlights in use on eight locomotives of the Georgia Southern & Florida R. R., and they are claimed to fully repay their cost (about $375 each) by the saving in stock killed. They make objects visible at a distance of one-half to three-fourths of a mile, and it is said that switch targets can be extinguished by the engineer more readily than in the daytime. Electric headlights have been in use on the Vandalia line for some years.

THE MARION STEAM SHOVEL CO., of Marion, O., has a contract for a dredge with hull 84 × 46 ft., and a boom 80 ft. long, for the Consolidated Canal Co., to be used in dredging irrigation canals in Arizona. The machine can excavate to a depth of 25 ft. below the surface of the water, raise and dump the material 34 ft. above the surface of the water, and at a distance of 80 ft. from the center of dredge on either side. With this machine the company's largest canals can be completed with one cut.

NEW COMPANIES.—American Steam Excavating Co., Marshall, Tex.; $50,000; H. D. W. Smith, John Ole, E. J. Fry and J. M. Weeks.——American Refuse Crematory Co., Chicago, Ill.; $1,000,000; Bertrand Walker, George Beach and R. H. Woodbury.——Mark Equipment Co., East St. Louis, Ill.; $10,000; railway supplies; F. S. Taggart, H. L. Bauer and F. E. Milsen. ——Johnson Syndicate Construction Co., Topeka, Kan.; $2,000,000; gas engines; F. B. Johnson, W. P. Hall and R. G. Martin.——D. K. Martin Roofing & Mfg. Co., New York, N. Y.; $10,000; brick, tile and gravel roofing, cellars, sewers, etc.; D. K. Martin, Whitestone, N. Y.; R. J. Beach and E. T. Deehan, New York, N. Y.——Columbian Water Power & Mfg. Co., Paterson, N. J.; $50,000; T. A. Macdonald, T. E. Snyder and George G. Vogel.

METAL MARKET PRICES.

RAILS.—New York: $24 to $25 at eastern mills and at tidewater; old rails, $12 to $13 for iron and $9.50 to $10 for steel. Pittsburg: $24 for standard sections. Chicago: $25 to $27; old rails, $11 to $12.50 for iron and $7 to $10 for steel.

TRACK MATERIAL.—New York: angle bars, 1.3 to 1.4 cts.; spikes, 1.7 to 1.9 cts.; track bolts, 2.2 to 2.4 cts. with square and 2.3 to 2.5 cts. with hexagon nuts. Chicago: angle bars, 1.3 to 1.35 cts.; spikes, 1.9 to 1.95 cts.; track bolts, 2.5 to 2.55 cts. with hexagon nuts.

FOUNDRY PIG IRON.—New York: $12.50 to $14. Pittsburg: $11.25 to $12. Chicago: $12 to $13.50.

LEAD.—New York: 3.15 to 3.2 cts. Chicago: 3.05 cts.

NAILS.—Pittsburg: $1.10 for wire and 95 cts. for cut at mill.

STRUCTURAL MATERIAL.—New York: beams, 1.55 to 2.25 cts.; channels, 1.6 to 2 cts.; angles, 1.55 to 1.7 cts.; tees, 1.75 to 2 cts.; universal mill plates, 1.5 to 1.65 cts.; steel plates, 1.4 to 1.55 cts. for tank, 1.6 to 1.7 cts. for shell, 1.9 to 2 cts. for flange, 2.25 to 2.5 cts. for firebox. Pittsburg: beams, 1.4 cts.; channels, 1.4 cts.; angles, 1.4 to 1.5 cts.; tees, 1.6 to 1.65 cts.; universal mill plates, 1.4 to 1.5 cts.; steel plates, 1.3 to 1.35 for tank, 1.5 to 1.6 cts. for shell, 1.65 to 1.7 cts. for flange, 1.75 to 1.85 cts. for ordinary firebox and 2 to 2.15 cts. for railway firebox. Chicago: beams, 1.55 to 1.6 cts.; channels, 1.55 to 1.6 cts.; angles, 1.55 to 1.6 cts.; tees, 1.85 to 2 cts.; universal plates, 1.55 to 1.6 cts.; steel plates, 1.5 to 1.6 cts. for tank, 1.7 to 1.8 cts. for shell, 1.9 to 2 cts. for flange, 2.75 to 5 cts. for firebox.